LA-UR-05-0286 **September 2005**

Approved for public release;
distribution is unlimited.

Title

Management Review Draft

Los Alamos National Laboratory Wildland Fire Management Plan

Prepared by

Ecology Group

Los Alamos National Laboratory

Los Alamos
NATIONAL LABORATORY

Los Alamos, New Mexico 87545

Edited by Hector Hinojosa, Group IM-1

Composition by Teresa Hiteman, Group ENV-ECO

Cover photo: Piñon-juniper woodland south of Pajarito Acres (March 31, 2003) following mechanical fuels reduction thinning.

Executive Summary

A wildland fire management plan (WFMP) is a strategic plan that describes a program to manage risk associated with wildland fires. Recent large wildfires in the area, including the La Mesa Fire (1977), the Dome Fire (1996), the Oso Fire (1998), and the Cerro Grande Fire (2000), clearly demonstrate that forests on and surrounding Los Alamos National Laboratory (LANL) are susceptible to destructive crown fires. There are approximately 12,000 people employed at LANL. The value of fixed assets (structures) alone at LANL has been estimated in excess of eight billion dollars. Wildland fires also present the risk of cultural and natural resources damage, including the potential for radiological or hazardous material releases due to the operations and facilities present at LANL. The overall goals of wildland fire management at LANL address these issues. In addition, this plan responds directly to requirements set forth in the University of California Contract, Appendix G and Department of Energy/National Nuclear Security Administration (DOE/NNSA) policy regarding wildland fire management at LANL.

The 2001 Federal Wildland Fire Management Policy (adopted by DOE in February 2003) emphasizes the need for wildfire management plans to support existing land and resource management plans. Wildland fire management activities will be integrated with current LANL land and resource management plans. The Site Planning and Project Initiation Group will be involved in coordinating wildland fire management activities through the LANL Comprehensive Site Plan and the annual Ten-Year Comprehensive Site Plan as appropriate. Wildfire management actions will also be reviewed in accordance with the Site and Project Planning Laboratory Implementation Requirement, an institutional environmental, safety, and health regulatory compliance process with DOE/NNSA oversight.

The LANL Wildland Fire Management Program strategy is organized around a set of core activities: planning and preparedness, fire suppression, fuels mitigation through use of prescribed fire, fuels mitigation through activities other than prescribed fire (e.g., thinning, mowing, herbicides), rehabilitation, and monitoring. The concepts of adaptive management and Integrated Work Management are incorporated into the wildland fire management process.

A June 5, 2000, Memorandum from the Secretary of Energy issued a moratorium on prescribed fires on DOE property until sites had an approved WFMP. On October 18, 2004, a Finding of No Significant Impact was issued for the burn alternative to the Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory. DOE/NNSA approval of this WFMP will provide the necessary authority to initiate a prescribed fire program at LANL.

The LANL Associate Directorate for Security and Facility Operations and the Associate Directorate for Technical Services collaborate to implement wildland fire management at LANL. The Los Alamos County Fire Department provides wildfire suppression support for LANL. The New Mexico Joint Powers Agreement, between the state Forestry Division, DOE, Department of Interior, and Department of Agriculture, provides a

mechanism for sharing resources for an extended wildfire attack. Integration between DOE, NNSA, LANL, and external agencies with responsibilities for wildland fire management occurs through the Interagency Wildfire Management Team, which has been operating since 1996.

Ten-year budget forecasts are provided for wildfire-related tasks such as thinning, prescribed fire, fire road maintenance, utilities maintenance, WFMP updates, wildfire hazard model updates, and the fuels monitoring program. The estimated cost is approximately 1.5 million dollars a year for a comprehensive wildfire management program.

The LANL WFMP proposes a cost-effective, long-term plan to reduce and manage wildfire risk through internal and external cooperation. LANL staff continues to be very effective in responding to the challenge of wildland fire management, however, there is a collective concern about maintaining this capability without a long-term institutional wildland fire management strategy. This plan addresses gaps that employees with wildland fire management responsibilities have identified in current operations. These gaps include the following:

- No recognized institutional authority for wildland fire management.
- No long-term institutional funding source for implementing a wildland fire management program under the DOE Wildland Fire Management Policy.
- No long-term institutional operational plan for wildfire risk reduction (forest thinning, fuels reduction, and maintenance of previously thinned areas).
- No long-term institutional support for monitoring and evaluation of fuels-reduction effectiveness, wildfire hazards, and fire behavior modeling.
- No current capability for prescribed fire use.

Adoption and implementation of the WFMP will close these gaps and provide comprehensive wildfire risk management for LANL and the surrounding community.

December 2001

February 2002

November 2003

September 2005

Time series photos from a piñon-juniper woodland site in TA-36. December 2001 shows site before thinning treatments. This is typical of most piñon-juniper woodland on the Pajarito Plateau, bare soils, too many trees, and too little understory vegetation. February 2002 shows the same site after the thinning treatment. Most of the trees have been removed from the site to reduce fuel levels and improve conditions for understory vegetation. November 2003 shows impact of bark beetle attack following several years of drought. Although most of the piñon in this photo were killed, there are surviving piñon in this area. At this time there has been some understory plant response but primarily from weedy species. September 2005 shows substantial understory vegetation, primarily in response to the wet winter/spring of 2004/2005. Most of the species in the photo are native herbaceous perennials like snakeweed, groundsel, and purple aster.

Contents

Figures

Tables

List of Acronyms

ADO	Associate Directorate for Operations
ADSFO	Associate Directorate for Security and Facility Operations
ADTS	Associate Directorate for Technical Services
BAER	Burned Area Emergency Rehabilitation
CGRP	Cerro Grande Rehabilitation Project
CSP	Comprehensive Site Plan
DOE	Department of Energy
DX	Dynamic Experimentation Division
EJRC	East Jemez Resources Council
EM&R	Emergency Management and Response Group
ENV-ECO	Ecology Group
ENV-MAQ	Meteorology and Air Quality Group, Risk Reduction and Environmental Stewardship Division
ENV-WQH	Water Quality and Hydrology Group, Risk Reduction and Environmental Stewardship Division
EOC	Emergency Operations Center
EOO	Emergency Operations Office
EO-FIRE	Fire Protection Group
ERC	energy release component
FEMA	Federal Emergency Management Agency
FMD	Facilities Management Division
FMD-UI	Utilities and Infrastructure Group
FMZ	Fire Management Zone
FY	Fiscal Year
HSR	Health, Safety, and Radiation Protection (Division)
IRMP	Integrated Natural and Cultural Resources Management Plan
IWMT	Interagency Wildfire Management Team
LAAO	Los Alamos Area Office
LANL	Los Alamos National Laboratory
LAFD	Los Alamos County Fire Department
LIR	Laboratory Implementation Requirement
LPR	Laboratory Performance Requirement
M&O	management and operations
MIST	Minimum Impact Suppression Tactics
NEPA	National Environmental Policy Act
NFDRS	National Fire Danger Rating System

NFIRS	National Fire Incident Reporting System
NFPA	National Fire Protection Association
NNSA	National Nuclear Security Administration
PM-IP	Infrastructure Projects Group
RxBP	Prescribe Fire Burn Plan
SSMO	Space and Site Management Office
SWEIS	Site Wide Environmental Impact Statement
TA	Technical Area
TYCSP	Ten-Year Comprehensive Site Plan
WFMP	Wildland Fire Management Plan
UC	University of California
USFA	United States Fire Association
WHRP	Wildfire Hazard Reduction Project

1.0 Introduction

1.1 Purpose of the Plan

Following the Cerro Grande Fire of May 2000, Los Alamos National Laboratory (LANL) received emergency funding and the Cerro Grande Rehabilitation Project (CGRP) was established to address immediate wildfire hazards to LANL. The CGRP was funded for four years and mitigated many but not all of the fire hazards identified by the CGRP team. The Wildland Fire Management Plan (WFMP) and program are designed to address outstanding wildfire hazards and provide for long-term maintenance of wildfire risk. The goal is to establish a viable long-term comprehensive program to minimize the risk of wildland fire to people, facilities, and the environment.

In addition, this plan will meet institutional requirements set forth in Department of Energy (DOE) Order 450.1, *Environmental Protection Program* (DOE 2003a). The order mandates the inclusion of policies, procedures, and training to address significant environmental impacts. The order specifically identifies wildland and operational fires as an impact that should be considered.

A February 24, 2003, memorandum (DOE 2003b) from the Secretary of Energy to the Under Secretary for Energy, Science and Environment and the Administrator of the National Nuclear Security Administration (NNSA) directed each Program Secretarial Officer to ensure that all sites subject to wildland fires develop wildland fire management plans consistent with the *Review and Update of the 1995 Federal Wildland Fire Management Policy* (NIFC 2001). The policy was issued in direct response to one of the recommendations of DOE's independent Commission on Fire Safety and Preparedness issued on May 28, 2002. The guiding principles of the Policy are as follows:

1. Firefighter and public safety is the first priority in every fire management activity.
2. The role of wildland fire as an essential ecological process and natural change agent will be incorporated into the planning process.
3. Fire Management Plans, programs, and activities support land and resource management plans and their implementation.
4. Sound risk management is a foundation for all fire management activities.
5. Fire management programs and activities are economically viable, based upon values to be protected, costs, and land and resource management objectives.
6. Fire Management Plans and activities are based upon the best available science.
7. Fire Management Plans and activities incorporate public health and environmental quality considerations.
8. Federal, State, tribal, local, interagency, and international coordination and cooperation are essential.
9. Standardization of policies and procedures among federal agencies is an ongoing objective.

Work Smart Standards in Appendix G of the University of California (UC) Prime Contract requires adoption of National Fire Protection Association (NFPA) National Fire Codes (most recent additions) with the exception of NFPA 70, *National Electrical Code* (NFPA 2005) and NFPA 5000, *Building Construction and Safety Code* (NFPA 2003a).

NFPA 1143, *Standard for Wildland Fire Management* (NFPA 2003b) and NFPA 1144, *Standard for Protection of Life and Property from Wildfire* (NFPA 2002a) are particularly relevant. NFPA 1143 provides guidance for an institutional wildland fire management program including risk/hazard assessment and mitigation, preparedness, and incident management. NFPA 1144 provides specific guidance for protecting lives and property from wildland fire.

Recent large wildfires in the area, including the La Mesa Fire (1977), the Dome Fire (1996), the Oso Fire (1998), and the Cerro Grande Fire (2000), clearly demonstrate that forests on and surrounding LANL are susceptible to destructive crown fires. These large, catastrophic fires were made possible because of 1) a ready source of ignitions from lightning and people, 2) a tendency for hot, dry, and windy weather conditions to occur in the early summer months in the Los Alamos region, and 3) the presence of heavy fuels in the overgrown forests. Of these three factors, only fuels can be readily managed. Therefore, active fire management is required to protect Laboratory resources.

Approximately 12,000 people are employed at LANL. The value of fixed assets (structures) alone at LANL has been estimated in excess of eight billion dollars (Tomecek et al. 2003). Due to the operations and facilities present at LANL, wildland fires can result in radiological or hazardous material releases. Based on the experiences of the Cerro Grande Fire, many LANL facilities are incorporating wildland fires as accident scenarios with Documented Safety Analyses or a Fire Hazard Analysis exposure fire (Tomecek et al. 2003).

This WFMP provides the basis for developing and managing an efficient, effective, and regionally integrated wildland fire management program. In general, DOE sites are responsible for developing, implementing, and overseeing protection programs for individuals and assets under their jurisdiction. This not only includes protecting assets from internal structural fire damage, but also protecting these assets from the conflagration potential associated with external wildfire. Format and content of this plan are based on DOE G 450-1.4, *Implementation Guide for Wildland Fire Management Program* (DOE 2004).

A wildland fire management program consists of the full range of activities and functions necessary to plan and respond to wildland fire, to manage fuels, and to rehabilitate burned areas through a safe and cost-effective program that protects, maintains, and enhances DOE's assets. General recommendations for the development of a wildland fire management program (DOE G 450-1.4) are as follows:

a. Integrate consideration of fire management into the DOE land use planning and management process, objectives, prescriptions, and practices. When developing fire management direction in the land use planning and management process, identify the foreseeable effects or enhancements that fire would have on the environment as well as its impact to any hazardous or mission critical areas including National Security interests.

b. Develop and maintain a fire management plan based on direction in the site's land use planning and management process. Amend the fire management plans where necessary to meet land management objectives.

c. Conduct fire management planning, preparedness, suppression, monitoring, and, where necessary and appropriate, prescribed fire use, on an interagency basis with stakeholder involvement.

d. Observe these fire management priorities on all fires: first, ensure firefighter, worker, and public safety; and, second, protect mission property and natural and cultural resources based on relative values.

e. Initiate suppression of all wildland fires except those fires classified as prescribed fires (when authorized) and any site operational fires conducted in wildland areas according to the sites' permitting process or other procedures.

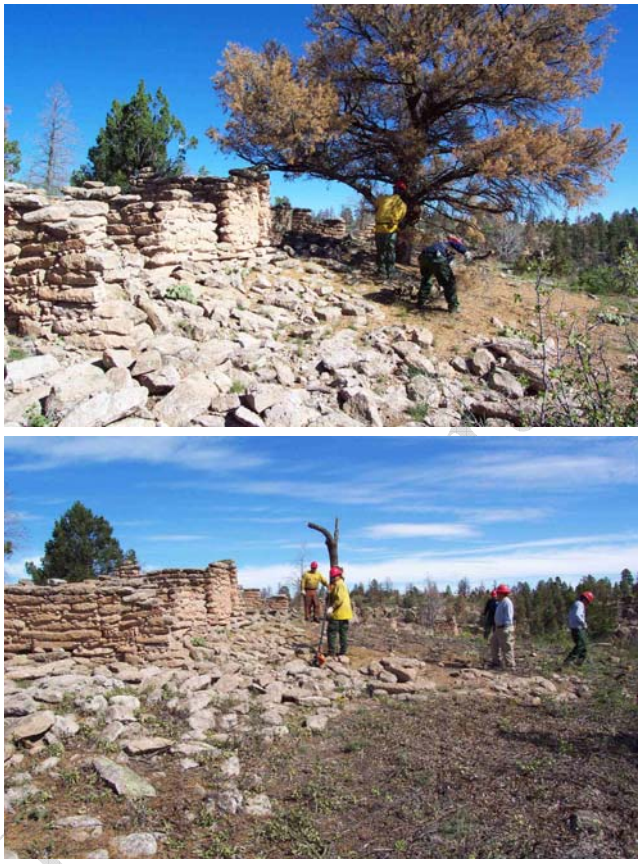
f. Protect the interface between wildlands, facilities, and bordering structures from damage according to NFPA Standard 1144 *Protection of Life and Property from Wildfire*.

g. Where necessary, include wildland fire risk assessments in other safety documents such as the Fire Department Baseline Needs Assessment, facility Documented Safety Analysis and Fire Hazards Analysis, or other documents analyzing hazards to specific DOE structures, processes, or programs.

1.2 Collaboration

The LANL Associate Director for Security and Facility Operations (ADSFO) is responsible for the development, implementation, and maintenance of the LANL WFMP. However, effective wildland fire planning and management is possible only with the collaboration of a variety of internal and external organizations. Within LANL, Emergency Management and Response (EM&R) of the Emergency Operations Office (EOO) is responsible for conducting the internal, contractor, and interagency preparation for and response to wildland fires. The Fire Protection Group of the Emergency Operations Office (EO-FIRE) conducts facility Fire Hazard Analyses, Facility Surveillances, and applies administrative and engineering controls to prevent wildland fires during operational activities. The Utilities and Infrastructure Group (FMD-UI) of the Facilities Management Division (FMD) is responsible for monitoring and managing fire hazards within utility corridors. The Los Alamos County Fire Department (LAFD) conducts the initial attack on wildland fires. Project Management Division - Infrastructure Projects (PM-IP) manages subcontractors to implement wildfire fuels-reduction treatments to maintain the Laboratory in a state of reduced hazard from wildland fires. The Ecology Group of the Environmental Stewardship Division (ENV-ECO) monitors and models LANL wildland fire hazard conditions and protects cultural resources and sensitive species habitat from disturbances related to wildland fire management. The Water Quality and Hydrology Group (ENV-WQH) conducts burned area rehabilitation and regulatory compliance, and the Meteorology and Air Quality Group (ENV-MAQ) provides weather data and weather forecasting for fire behavior modeling and regulatory compliance. The Space and Site Management Office (SSMO) provides the link to overall LANL comprehensive site planning. As the need arises, other LANL organizations join in this collaboration. These organizations and their roles and responsibilities are further discussed in Section 4.0, Wildland Fire Management Program Components.

Interagency communication and planning are accomplished through a number of means. Wildfire-related information is disseminated between local stakeholders through regular bi-weekly meetings of the Interagency Wildfire Management Team (IWMT). The IWMT is a multi-agency team that meets to identify, discuss, and address issues pertaining to wildfire mitigation and management in the Los Alamos region. The emphasis of the team is to take hands-on action needed to protect human life, improve firefighting safety, improve firefighting access, protect property, and maintain forest health. LANL staff also participates as active members of the East Jemez Resources Council (EJRC), which coordinates interagency collaboration on natural resources management issues. Other members of these organizations include regional land management agencies, tribes, Los Alamos County, and other stakeholders. These same agencies are represented in a group that is currently working on a regional wildland fire management plan to address common wildfire and land management goals through interagency cooperation.



San Ildefonso forestry crew thinning vegetation around Nake'muu at TA-37. Fuels-reduction treatments help protect cultural sites from wildfire and falling trees. Slash from thinned vegetation is used to stabilize the site. LANL has contracted with crews from San Ildefonso, Santa Clara, Cochiti, and Jemez Pueblos for fuel-reduction and rehabilitation work on and off cultural sites.

LANL staff also collaborates with external agencies to provide regional wildfire suppression support. The New Mexico Joint Powers Agreement (EMNRD 2003) establishes guidelines for interagency wildland fire protection. The agreement is signed by the DOE, the Department of Agriculture (US Forest Service), the Department of Interior (Bureau of Land Management and National Park Service), and the State of New Mexico. In cases where an Incident Commander judges or anticipates that a wildfire will require more than initial attack suppression activities, the Santa Fe Zone Coordinating Group is contacted for wildland firefighting resources. LANL and LAFD staff then participate in a Unified Command with a responding interagency Incident Command Team. For fires on DOE property, EM&R is preauthorized to use unbudgeted funds to respond to wildland fire as needed.

NNSA is the LANL landlord and provides some resources for a permanent interagency fire cache and three-pad helibase maintained at Technical Area (TA) 49, located on the boundary between LANL and Bandelier National Monument. Fire crews, helicopters,

and other firefighting resources may be based at the fire cache during the fire season depending on fire danger levels and resource availability.

Representatives from the US Forest Service, Bandelier National Monument, LANL, and Los Alamos County are all participating in efforts to reduce wildland fire hazards in the Los Alamos wildland-urban interface. Many of these efforts have been coordinated through the IWMT and have involved cooperative efforts on the part of a number of agencies. Recent projects include the following:

- Defensible Space Thinning (County of Los Alamos for private residences, funded by the Federal Emergency Management Agency [FEMA])
- Fuel Mitigation and Forest Restoration (County of Los Alamos, thinning projects on County property, US Forest Service as a cooperator)
- Valles II Hazardous Fuels Reduction Project (Santa Fe National Forest and Bandelier National Monument, thinning and prescribed burning to the west and south of Los Alamos townsite and LANL)
- CGRP (NNSA, thinning and slash removal at LANL)

1.3 Link to Policy/Orders/Contracts

This WFMP is a detailed course of action to carry out wildland fire management site policies and help achieve fire protection objectives. The following policies, orders, and contracts define LANL's responsibility for wildland fire management.

The accident scenario analysis section of the Site-Wide Environmental Impact Statement for Continued Operation of LANL (SWEIS) identified wildfire as a credible risk to LANL that could result in significant impact to the region. The Record of Decision (DOE 1999a) and Mitigation Action Plan (DOE 1999b) for the SWEIS (DOE 1999c) require LANL to prepare and implement a long-term strategy to address site-specific wildland fire management issues.

The DOE Wildfire Management Policy (DOE 2003b) states that DOE sites are required to have wildland fire management plans in place that are consistent with the *2001 Federal Wildland Fire Management Policy and Implementing Actions*. In addition, "this directive will require contractors to implement a program, as appropriate, to protect site resources from wildland and operational fires as part of their Integrated Safety Management System." The guidance document for the WFMP (DOE G. 450-1.4) was developed and provided to assist DOE [programs in meeting the requirements in DOE O. 450-1.

Work Smart Standards in Appendix G of the UC Prime Contract requires adoption of NFPA National Fire Codes (most recent addition) with the exception of NFPA 70, *National Electrical Code*, and the NFPA 5000, *Building Construction and Safety Code*. NFPA 1143, *Standard for Wildland Fire Management*, and NFPA 1144, *Standard for Protection of Life and Property from Wildfire*, are particularly relevant. NFPA 1143 provides guidance for an institutional wildland fire management program including risk/hazard assessment and mitigation, preparedness, and incident management. NFPA 1144 provides specific guidance for protecting lives and property from wildland fire.

The UC contract, W-7405-ENG-36, includes the applicable mandatory DOE Orders and compliance documents in Appendix G. Of primary importance for wildland fire management are the following:

DOE Order 420.1, *Facility Safety,* contains the basic requirements for the fire protection program as a whole. Applicable NFPA Codes and Standards are mandatory as stipulated by DOE Order 420.1. DOE Order 420.1 also requires nuclear facility safety analysis reports to identify those systems, structures, components, and programs that are important to the safety basis assumptions and consequences.

DOE Order 450.1, *Environmental Protection Program,* requires the development of a site Environmental Management System as part of Integrated Safety Management. The Order specifically notes that protection of resources from wildland and operational fires be considered.

DOE Implementation Guide G 450-1.4, *Wildland Fire Management Program for use with DOE 450.1*.

DOE Order 151.1A, *Comprehensive Emergency Management System,* has many references that address the requirement of the emergency response organization in all types of emergencies. It also addresses the issue of having an Incident Command Structure within the organization.

The DOE Implementation Guide G-420.1/B-0 G-440.1/E-0, *Implementation Guide for DOE Orders 420.1 and 440.1: Fire Safety Program,* provides more detailed information in implementing the desired programmatic elements for the Fire Department into the Fire Protection Program.

10CFR Part 851, *Worker Safety & Health Program*.

Site documents relating to wildland fire management include the following Laboratory Performance Requirements (LPR) and Laboratory Implementation Requirements (LIR):

- LPR 402-00-00.3, *Performance Requirement: Worker Health and Safety*
- LPR 403-00-00.0, *Performance Requirement: Emergency Management*
- LIR 402-910-01.6, *LANL Fire Protection Program*
- LIR 403-00-01, *LANL Emergency Management*

2.0 Relationship to Land Management Planning

2.1 Reference to Planning Documents

The 2001 Federal Wildland Fire Management Policy emphasizes the need for wildfire management plans to support existing land and resource management plans. At LANL, an important aspect of the planning process is maintaining compliance with applicable Federal and State regulatory requirements (e.g., National Environmental Policy Act, Clean Water Act, National Historic Preservation Act, etc.). This compliance process ensures that all compliance documentation is in place and maintained as part of the activities associated with institutional wildland fire management. Programmatic actions

are reviewed in accordance with the Site and Project Planning LIR, an institutional environmental, safety, and health regulatory compliance process with DOE/NNSA oversight.

Wildland fire management activities will be integrated with current LANL land and resource management plans. The Site Planning and Project Initiation Group (SSMO-SPPI) will be involved in coordinating wildland fire management activities through the LANL Comprehensive Site Plan (CSP; LANL 2001a) and the annual Ten-Year Comprehensive Site Plan (TYCSP; LANL 2004a), as appropriate.

The LANL TYCSP is the NNSA-directed facility and infrastructure plan for the site. All NNSA sites within the complex prepare a TYCSP annually per specific guidance from NNSA Headquarters. The TYCSP supports facilities and infrastructure long-range and annual planning, budget formulation, decision-making, and future years analyses. The primary function of the TYCSP is to focus management attention on the needs of current and future real property asset (i.e., facilities and infrastructure) at each site in support of directed stockpile work and campaign programmatic requirements.

The TYCSP generally acknowledges the existence of wildland fire management as part of LANL's site land management activities. However, as a NNSA facilities and infrastructure plan, it is not intended to be the document that illustrates or reports on the integration of wildland fire management activities with other site management and operations activities.

Wildland fire planning and management are inherently site-specific activities, best implemented by the management and operations (M&O) contractor under the guidance and oversight of NNSA. These activities are communicated more clearly and efficiently when described in planning documents that are also developed by the site M&O contractor as part of their management and operations responsibilities. The wildland fire planning and management activities described in this WFMP are linked to the site's broader comprehensive planning process through the LANL CSP.

The LANL CSP is a M&O contractor-directed land use management plan that integrates a broad set of site planning elements (e.g., land use, transportation, security, utilities, facilities, environment/safety/health, and quality environment) as a conceptual framework for pursuing efficient and sustainable site management. The most recent updates of the LANL CSP were in 2000 and 2001. The CSP 2001 presents an essential update of the CSP 2000 to reflect significant changes following the Cerro Grande Fire in May 2000.

The broad planning elements described in the LANL CSP are supported by more specific land management plans. In the Record of Decision for the SWEIS (DOE 1999a), DOE recognized the need to address site-specific wildland fire management issues. The accident scenario analysis section of the SWEIS identified wildfire as a credible risk to LANL that could result in significant impact to the region. To mitigate this potential impact, DOE/NNSA committed to addressing the issue by developing and implementing a Wildfire Hazard Reduction Project (WHRP) Plan. The Cerro Grande Fire of 2000 hastened the development of the WHRP Plan, which was completed in April 2001 (LANL 2001b). The Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at LANL (DOE/EA-1329), a Biological

Assessment, a Floodplains and Wetlands Assessment, and a site-wide cultural resources protection and management strategy provided the regulatory compliance-assurance package for activities described in the WHRP Plan. These documents were used as the planning and compliance envelope for the CGRP wildfire hazard mitigation activities that were implemented in response to the Cerro Grande Fire. The WHRP, its environmental assessment, and associated compliance documentation also serve as the primary planning and compliance assurance documentation for the fuels-reduction activities described in this document.

Another requirement of the SWEIS Record of Decision was the development and implementation of an integrated natural resources management plan (DOE 1999b). In September 2002, NNSA issued the *Integrated Natural and Cultural Resources Management Plan for Los Alamos National Laboratory* (IRMP; NNSA 2002). The IRMP is a site-specific policy response to a series of Executive Orders, DOE Orders, and Policies that stress the need for a comprehensive and integrated approach to managing facility and land resources. The NNSA Los Alamos Site Office transmitted the IRMP to LANL with a mandate to implement the plan beginning October 2002. In response, LANL is developing and intends to implement an Environmental Management System under DOE Order 450.1. Under DOE O 450.1, Part 4.b.(1)(e), sites are explicitly required to protect resources from wildland and operational fires. Other completed or draft resource management plans include the LANL *Threatened and Endangered Species Habitat Management Plan* (LANL 1998), the *Biological Resources Management Plan* (draft), the *Cultural Resources Management Plan* (LANL 2004b), and the *Quality Management Plan* for the Meteorology and Air Quality Group (LANL 2003a). Wildfire and natural resource management-related activities will be coordinated through SSMO-SPPI, the Site-Wide Project Office (Environmental Stewardship Division), and other appropriate groups.

2.2 Reference to Policy Documents

The LANL WFMP and the operations it encompasses are linked to DOE, NNSA, and LANL land management and planning processes through policy implementation and compliance with various Federal and State regulatory requirements. Since December 1994, DOE has communicated site land and facility use planning expectations through DOE Policy 430.1, *Land and Facility Use Planning*. This Policy establishes a commitment to manage DOE land and facilities as valuable national resources. This policy is intended to result in land and facility uses that support the Department's critical missions, stimulate the economy, and protect the environment. In April 2000, President Clinton signed Executive Order 13148, *Greening the Government Through Leadership in Environmental Management* (EO 2000). This Executive Order states, "each Federal agency is responsible for ensuring that all necessary actions are taken to integrate environmental accountability into agency day-to-day decision-making and long-term planning, processes, across all agency missions, activities and functions." The policy principles of both DOE P 430.1 and Executive Order 13148 are also addressed in DOE Order 450.1, *Environmental Protection Program*. Under DOE O 450.1, Part 4.b.(1)(e), sites are explicitly required to protect resources from wildland and operational fires.

The LANL Policy Office establishes a formal set of policies and procedures to translate statutory and contractual requirements into day-to-day work. The Policy Office is currently establishing a new policy hierarchy. There are five Performance Priority categories with underlying Governing Policies. Different aspects of wildfire management are incorporated into Facilities Management (Forestry) and Emergency Management (Wildland Fire) governing policies. These policies will be contained within the Infrastructure Performance Priority and Facilities Management (site and land management) and Emergency Management (wildland fire management) Governing Policies.

2.3 Goals and Desired Condition

The CSP is the institutional long-range site development plan for LANL. As such, the CSP portrays the large-scale concepts for site-wide development and the current activities proposed and planned to achieve them. The CSP 2001 provides new and updated information and recommendations for Laboratory decision makers regarding policies affecting development and maintenance. It encapsulates development recommendations to achieve the "desired end-state" of a Laboratory that can operate efficiently to accomplish the mission of enhancing global security. As a complement to this WFMP, the LANL CSP presents institutional goals and strategies that provide the institutional framework for wildland fire management from a comprehensive site management perspective.

Goals of the CSP:

1. To advance ongoing revitalization and maintenance so the Laboratory's work can be safely and efficiently performed.
2. To develop facilities that support and contribute to the core competencies of the Laboratory.
3. To create an efficient place to work that is comfortable, safe, secure, and aesthetically pleasing.
4. To create an environment that contributes to attracting and keeping top-quality personnel.

The CSP emphasizes environmental stewardship and collaboration with adjacent landowners. Section IV, Planning for Risk Reduction, was added to the supplement as a result of the Cerro Grande Fire. This section emphasizes the "continued need to plan for and implement risk-reduction improvements for the Laboratory's future safety and security." Wildfire –related safety issues and initiatives identified in the document include the need for fire prevention programs, fuel load mitigation, flood mitigation, emergency communications, and evacuation routes.

The *Site + Architectural Design Principles* (LANL 2001c) is another planning document that describes detailed planning principles and guidelines for site and architectural development at the project scale. One of three goals for the Site + Architectural Design Principles is to articulate the planning and design principles and guidelines to be incorporated in each Laboratory development project to continue to improve the functionality, safety, security, and physical appearance of the Laboratory environment. The recent fires on or near the Laboratory led to the inclusion of three safety site

development issues: fire management zones around facilities, general fire risk reduction guidelines, and landscape fire risk reduction guidelines.

3.0 Wildland Fire Management Strategies

3.1 General Management Considerations

The LANL Wildland Fire Management Program strategy is organized around a set of core activities: planning and preparedness, fire suppression, fuels mitigation through use of prescribed fire, fuels mitigation through activities other than prescribed fire (e.g., thinning, mowing, herbicides), rehabilitation, and monitoring. The concepts of adaptive management and Integrated Work Management are incorporated into the wildland fire management process.

3.1.1 Planning and Preparedness

Planning and preparedness activities are conducted before the fire season. In addition to organizational meetings within LANL groups, biweekly meetings of the IWMT and associated subcommittees are used to establish priorities, discuss budget, strategy, and collaboration on issues including

- an annual sitewide risk and hazard assessment to evaluate current hazards and plan upcoming mitigation activities,
- training requirements and upcoming training opportunities,
- mutual aid agreements and interagency collaboration,
- status of local and regional firefighting equipment and personnel,
- upcoming fire season projections, and
- fuels mitigation needs including possible use of prescribed fire.

3.1.2 Suppression

Currently, all wildland fire on LANL property is actively suppressed in a manner consistent with firefighter and public safety. NNSA contracts with the LAFD to provide structural protection and initial attack on wildland fires that occur on or threaten LANL property. Additional suppression resources may be requested through the Santa Fe Zone Coordinating Group.

3.1.3 Prescribed Fire

Unlike some local land-management agencies, the mission of LANL does not allow for a wildland fire use policy (managing wildfires for beneficial use). The policy of LANL is to suppress any and all wildland fires. The NNSA has issued a Finding of No Significant Impact for the Final *Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, New Mexico* (NNSA 2004), which gives LANL the compliance authority to conduct prescribed burns on DOE property once a WFMP is approved. A prescribed fire use plan (Section 4.3.2) is a component of this WFMP and LANL staff intend to use prescribed

fire as a tool to manage wildfire fuels in areas where it is safe, effective, and economical. Prescribed fires will be conducted in collaboration with staff from the US Forest Service and/or Bandelier National Monument, both of which maintain active prescribed fire programs.

3.1.4 Non-fire Fuels Reduction

The primary means of wildfire hazard reduction will be through non-fire fuels treatments such as thinning, mulching, and mowing. Annual non-fire fuels reduction activities will be implemented according to hazard priority and budget constraints and in a manner that enhances ecosystem health when possible and appropriate.

3.1.5 Emergency Rehabilitation and Restoration

Rehabilitation and restoration activities will be planned and implemented as needed. Wildfires and activities associated with suppression and fuels mitigation can lead to extensive disturbance of soils and vegetation and may require rehabilitation. All efforts will be made to reduce the potential for these disturbances, such as the use of minimum impact suppression techniques (MIST). Potential rehabilitation and restoration procedures are similar to those used by Interagency Burned Area Rehabilitation (BAER) teams and are described in a LANL rehabilitation report (LANL 2002a).

3.1.6 Monitoring and Adaptive Management

Wildfire fuel levels in burned, thinned, and undisturbed areas will be monitored annually to provide current, accurate data for sitewide and site-specific wildfire hazard assessment and real-time modeling of wildfire behavior. Monitoring data also provide a means to quantitatively assess treatment effectiveness and alter treatment methods if necessary. This process of adaptive management, the same principles used in Integrated Work Management, Integrated Safety Management, and Integrated Safeguards and Security Management, will allow for continuous improvement of activities.

3.1.7 Wildland Fire Management Strategies by Fire Management Zone

LANL has been divided into three fire management zones (FMZs) for the purposes of wildland fire management (Figure 1). These zones differ in the risks they represent to Laboratory facilities, personnel, and firefighters and in their prescriptions for wildland fire risk reduction.

3.1.7.1 FMZ 1- Defensible Space (includes transportation/evacuation corridors and utility corridors)

Defensible space is the area directly adjacent to Laboratory facilities. Crown fires in this zone represent the greatest threat to worker safety and to Laboratory operations. Prescriptions for fuels mitigation in this zone are based on "Urban-Wildland Interface Code 2000" (IFCI 2000) and described in the WHRP (LANL 2001b). These prescriptions are designed to create areas that are free of crown fires and limit surface fires to low flame lengths to allow firefighters safe access to fight fire around facilities. In extreme fire hazard areas, the first 50 ft (15 m) from a building would be cleared of combustible trees and brush. The next 50 ft (15 m) would be thinned to a tree density of

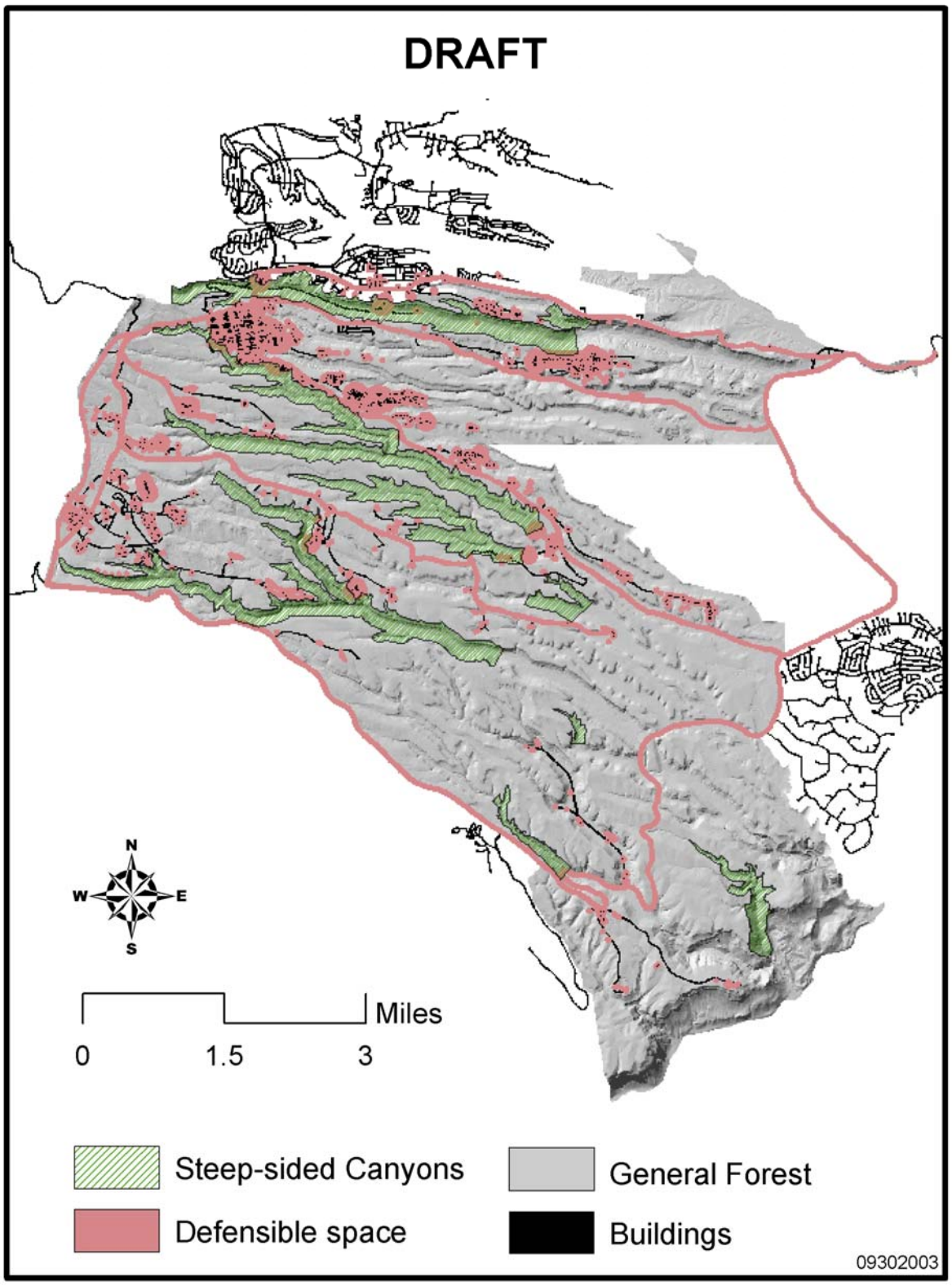


Figure 1. LANL Fire Management Zones.

no more than 50/acre (120/ha) and limbs should be removed from the lower 8 ft (1.6 m) on all residual trees. In high fire hazard areas, the first 25 ft (7.5 m) would be cleared of combustible trees and brush and the next 25 ft (7.5 m) would be thinned as described. In moderate fire hazard areas, the first 10 ft (3 m) and 20 ft (6 m) will be cleared and thinned, respectively. Low fire hazard areas are cleared out to 10 ft (3 m) as a standard practice.

The following documents contain guidelines for facility design and fuels mitigation in the Defensible Space Zone:

- NFPA 1144, *Standards for Protection of Life and Property from Wildfire* (NFPA 2002a)
- LA-UR-01-5383, *Site + Architectural Design Principles* (LANL 2001c)
- *International Fire Code Institute Urban-Wildland Interface Code* (IFCI 2000)

Direct attack will almost always be conducted in this zone. Fuels mitigation will be accomplished through non-fire fuel treatments.

3.1.7.2 FMZ 2-Steep-sided Canyons

LANL is dissected in an east-west direction by several deep canyons. These canyons tend to be heavily vegetated on their north-facing slopes because of moist conditions and also contain habitat for threatened species. Few of these canyons have road access.

These canyons represent dangerous conditions for firefighters and should not be considered for direct ground attack. Because of the habitat needs of threatened species, fuel treatment options within these canyons are limited but both prescribed fire and non-fire treatments could be used, as appropriate. Fuel breaks may be used around the perimeter of steep-sided canyons to reduce the possibility of crown fire spread from the canyons to surrounding areas.

3.1.7.3 FMZ 3-General Forest Areas

General forest areas are those areas not included in defensible space or within steep-sided canyon zones. Prescribed fire and non-fire treatments can be used in this zone to minimize the possibility of an extensive crown fire. LANL personnel will continue to analyze the fuel loading conditions and tree mortality in the general forest areas and determine the need for additional thinning or maintenance of currently thinned areas. Direct or indirect attack may be conducted in this zone, depending on the decision of the incident command team.

3.2 Wildland Fire Management Goals

Overall goals of wildland fire management at LANL (LANL 2001b) are as follows:

1. Protect the public, LANL workers, facilities, and the environment from catastrophic wildfire.
2. Prevent interruptions of LANL operations from wildfire.
3. Minimize impacts to cultural and natural resources while conducting fire management activities.

4. Improve forest health and wildlife habitat at LANL and, indirectly, across the Pajarito Plateau.
5. Promote and support interagency collaboration for wildfire-related activities.

Site-specific goals of wildland fire management at LANL are as follows:

1. Suppress all wildland fires, consistent with firefighter and public safety.
2. Develop a cost-effective wildland fire preparedness program that includes the following:
   a. Identification of LANL-specific wildland fire hazards and risks and hazard areas within the jurisdiction and other hazards that negatively affect wildland fire control efforts.
   b. Identification of fire protection features such as water points, fire roads, natural and constructed firebreaks, and other areas or features that are beneficial to wildland fire control efforts.
   c. A list of resources, including personnel, apparatus, and equipment.
   d. A list of all cooperating Federal, State, and local agencies and other mutual aid resources and the procedures for requesting assistance from those agencies and resources.
   e. A reference to any and all existing mutual aid agreements, contracts, and other protection agreements applicable to wildland fire control efforts.
   f. A list of specific objectives relating to training, safety, response times, and staffing levels.
   g. A list of other resources that provide analyses of fire cause, identification of special fire hazards and risks, assessment of wildland/urban interface and intermix fire protections problems, and proposed measures to reduce fire occurrence.
3. Integrate fuels management planning into all appropriate activities.
4. Implement non-fire fuels management as a primary tool for reducing wildfire hazard.
5. Provide a mechanism for conducting prescribed burns to benefit, protect, maintain, and enhance DOE lands, to reduce future fire suppression costs, and to restore ecological processes.
6. Develop an institutional monitoring program and use monitoring data and modeling tools to assess the current wildland fire hazards and evaluate the effectiveness of current thinning treatments and rehabilitation activities.
7. Reduce the costs of fire suppression and damage to levels commensurate with available resources and mission objectives.
8. Secure stable institutional funding at an appropriate level for a comprehensive wildland fire management program.

The LANL WFMP, as well as the Santa Fe National Forest and Bandelier National Monument Fire Management Plans, are based on the *2001 Federal Wildland Fire Management Policy* (NIFC 2001) and consequently share common goals. In addition, these organizations all share common natural resource management issues that also lead to shared wildfire management goals.

4.0 Wildland Fire Management Program Components

4.1 Planning and Preparedness

4.1.1 Preparedness Actions

4.1.1.1 Fire Prevention, Community Education, Community Risk Assessment, and Other Community Assistance Activities (Firewise)

Before the Cerro Grande Fire in 2000, the County of Los Alamos began conducting an aggressive community education and assistance program. Each spring, representatives of the County, LANL, the US Forest Service, and the National Park Service hold a community meeting to discuss the upcoming fire season with County residents. Using money provided after the Cerro Grande Fire by FEMA, the County has been sponsoring a program to provide free assistance to homeowners to create defensible space around private residences.

Los Alamos County has prepared a draft Hazard Mitigation Plan (Los Alamos County 2005) as mandated by FEMA to meet the requirements of the Disaster Mitigation Act of 2000. The plan evaluates vulnerabilities and mitigation for potential hazards such as wildfire, flooding, drought, severe weather, rock fall, earthquakes, volcanoes, and natural health hazards such as West Nile virus. Wildfire remains the hazard of greatest probability to the communities of Los Alamos and White Rock.

The typical human-caused wildland fire in the LANL area is the result of an unattended campfire. Fireworks are also a common source of ignition. LANL experimental operations may result in fire starts but very rarely become wildland fires due to implementation of strict fire safety procedures (see description of the explosives testing hazard matrix, Section 4.1.1.4).

4.1.1.2 Annual Prevention Program

The overall goals and objectives for wildfire prevention at LANL are to reduce the risk of wildfire to the public, LANL personnel, facilities, and the environment. LANL organizations responsible for fire prevention monitor fire danger each season and make special orders and closures as needed (Section 4.1.3). They also conduct a wildland fire exposure analysis of each facility on a periodic basis. Facility managers are responsible for making sure all fire hazard analysis recommendations are implemented. Annual maintenance of firing sites is conducted to prevent operational fires. Table 1 describes the roles and responsibilities of the groups involved in wildland fire prevention.

LAFD suppresses approximately 15 to 20 wildfire starts a year. These actions are reported to the National Fire Incident Report System (described in Section 4.6.2).

4.1.1.3 Special Orders and Closures

NNSA is the LANL landlord and provides some resources for a permanent interagency fire cache and three-pad helibase maintained at TA-49, located on the boundary between LANL and Bandelier National Monument. Fire crews, helicopters, and other firefighting resources are based at the fire cache during the fire season depending on fire danger

Table 1. LANL Organizations Involved in Wildland Fire Prevention.

Lead Organizations	Roles and Responsibilities
EO-FIRE	With EM&R, apply administrative and engineering controls to prevent unauthorized ignition of wildland fires during operational activities. Plan and assess wildland vegetation management around facilities to minimize damage from wildland fire. Review changes to facility occupancy and other facility modifications for appropriate fire protection; prepare Fire Hazard Analyses.
EM&R	With EO-FIRE, apply administrative and engineering controls to prevent unauthorized ignition of wildland fires during operational activities.
LAFD	Provide on-site support during operational activities that could potentially ignite wildland fire and provide area-wide public education on wildland fire prevention and safety.
Dynamic Experimentation (DX) Division	Manage firing sites and firing site activity to minimize the potential for accidental ignition of a wildland fire during operational activities.

levels and resource availability. The National Park Service currently has a 20-yr land-use agreement with DOE that expires in 2019. Plans are underway to formalize a long-term lease for the property and expand the firefighting capabilities.

NNSA contracts with the LAFD to provide structural protection and initial attack on wildland fires that occur on or threaten LANL property. The current number of emergency responders allocated to LAFD is 117, with a minimum staffing level of 28 during each of three shifts. Under Extreme fire conditions, the minimum staffing level per shift is increased to 31. These shift responders are deployed strategically among five response stations to provide fire, emergency medical service, hazardous materials isolation, and rescue operations for LANL.

During the wildland fire season, official alerts may be issued by EO-FIRE and EM&R personnel that restrict LANL operational activities based on the level of fire danger (see activities restriction matrix in Appendix 1). In addition, undeveloped LANL property may be closed to recreational access depending on fire danger conditions.

4.1.1.4 Industrial Operations and Fire Precautions

The greatest risk of fire ignition from LANL operations occurs during explosive testing. DX Division has worked closely with the LAFD, EM&R, and ENV-ECO to develop a joint plan of evaluation and action that minimizes the escape-fire risk of explosive testing. Through many site visits, meetings, and discussions, a system of hazard evaluation and environmentally sensitive firing-site remediation has been devised that defines the conditions for explosive testing.

The procedure for evaluating a given experimental configuration as it interacts with the fire-hazard level at each firing site is outlined in Figure 2. This is <u>not</u> a procedure to guarantee there will be no fires ignited. It is the outline of a process that may allow certain explosive-driven tests to be fired safely after systematically considering the options available.

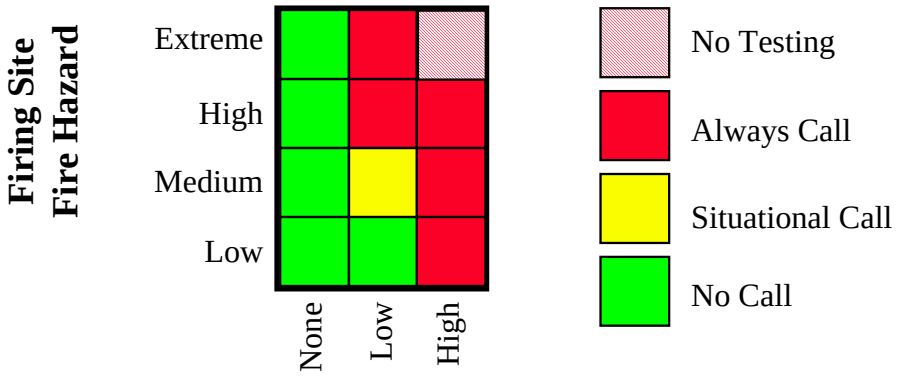


Figure 2. Description of the Hazard-Probability Matrix.

The horizontal axis is the probability of igniting a fire on or near the firing mound. This probability is evaluated by considering the composition and geometry of a test (i.e., the amount of explosive, the quantity and configuration of any metal parts, and past experience with similar experiments). The vertical axis is the fire-hazard level assigned by the LAFD and EM&R for the firing site and immediate surroundings. The various colored (shaded) squares indicate whether the LAFD is called to standby for a given test. The four possibilities are

- **No Call** - The LAFD is not informed of, nor required to, standby for the test. Either the test is fully contained such that no fragments or hot gasses escape, or the shot is extremely small and presents no hazard.
- **Situational Call** - The test is analyzed for fire-starting potential by the Firing Leader and the cognizant Technical Staff Member, the local conditions are factored in, and a determination is made. We always have the LAFD standby if there is any question of risk.
- **Always Call** - Our experience or technical evaluation of the test/hazard indicates a real possibility of starting a fire, therefore the LAFD is called to standby.
- **No Testing** - Our experience or technical evaluation of the test/hazard indicates a real possibility of starting a fire, and the LAFD cannot reasonably assure there will be no escape fire because of the local hazards (fuel load, fuel-moisture content, relative humidity, temperature, winds, etc.)

For normal firing operations, DX Division works with the LAFD and EM&R to identify and implement methods to reduce the hazard level at the firing sites, reduce the probability of a test igniting a fire, and reduce the probability of any fire spreading. We regularly take positive measures to mitigate both the probability of starting a fire (sand boxes/bags, water-filled containers, shot configuration changes) and the probability of a fire spreading (fuel loads, amount of equipment and personnel on standby, firing site selection). In most cases, these straightforward actions are satisfactory to continue testing. For those times when the regional fire hazard is extreme or above, we work even more closely with LAFD and EM&R to make a timely evaluation of the escape fire hazards at the individual firing sites.

The techniques that reduce the probability of escape fires can be categorized in three broad areas: 1. Test mitigation reduces the probability of igniting a fire by limiting flying debris (moving from right-to-left in the matrix); 2. Area mitigation reduces the fire hazard at the firing site (moving from top-to-bottom in the matrix); and 3. Enhanced procedures reduce the probability of a fire spreading. The goal of using this combination of techniques is to move the explosive testing operations to a place in the matrix where DX Division, LAFD, and EM&R have extensive experience, and are therefore confident that there will be no escape fires.

4.1.2 Fire Training Activities

NNSA contracts with the LAFD to provide initial attack on wildland fires that occur on or that are threatening LANL property. The LAFD is responsible for keeping personnel current on training. LAFD firefighters are trained to the NFPA 1051, *Standard for Wildland Fire Fighter Professional Qualifications* (NFPA 1995, 2002b), and the National Wildfire Coordinating Group Standards. All LAFD firefighters receive 48 hours of red card-equivalent training with an annual eight-hour refresher thereafter. They are also required to pass the criterion task test for fitness. Non-emergency personnel operating in hazardous conditions are trained in the use of fire extinguishers and fire watch techniques.

Neither LANL nor LAFD currently support fire staff personnel that are qualified to manage Type 3 or higher incidents (extended attack on wildland fire). However, as a part of the *New Mexico Resource Mobilization Plan 2003* (NMED 2003a), plan developers are reviewing the implementation of a required qualification system that would qualify all LAFD Battalion Chiefs and above as well as LANL EM&R incident command personnel to manage a Type 3 incident in the LANL/Los Alamos County service area.

4.1.3 Fire Season Readiness

Fire season readiness (or preparedness) at LANL involves ensuring that appropriate resources, information, and personnel are available and ready for the upcoming fire season (Table 2).

Table 2. LANL Organizations Involved in Preparedness.

Lead Organizations	Roles and Responsibilities
EM&R	Conduct internal, contractor, and interagency coordination for preparedness and response to wildland fire. Acquire and maintain infrastructure and equipment necessary to respond to wildland fire, including communications systems and fire cache equipment. Prepare and issue daily Fire Danger ratings during the fire season. Maintain preparedness levels consistent with current Fire Danger ratings.
LAFD	Acquire and maintain appropriate equipment to fight wildland fire. Be capable of deploying personnel meeting minimum qualifications of Wildland Firefighter I (NFPA 1051) and National Wildfire Coordinating Group Standards, and apparatus, for a threatening wildland fire.

4.1.3.1 Annual Preparedness Reviews

The LAFD maintains year-round readiness for firefighting. As the fire season approaches, the IWMT discusses current and anticipated fire danger conditions and the acquisition of interagency resources stationed at the TA-49 fire cache for wildland firefighting. LAFD firefighting equipment is inspected and maintained by UC subcontractors KBR, Shaw, and LATA.

4.1.3.2 Season Start and Stop Criteria with Typical Dates

There are no accepted criteria for determining start and stop dates for the wildfire season. Based on fire occurrence for the past 10 years (M. Rodgers, Bandelier National Monument , personal communication), the LANL-area fire season runs from mid-April to mid-August. The *Santa Fe National Forest Fire Management Plan* (SFNF 2005) states that the official fire season for the Forest runs from March 1 through November 1. Fires can occur throughout the year under the appropriate environmental conditions.

4.1.4 Fire Weather and Fire Danger

4.1.4.1 Weather Stations

Several meteorological stations are located throughout the Pajarito Plateau. A station at Bandelier National Monument (Tower) and one at LANL (TA-6) are used to provide climatological data for fire danger estimates (Table 3).

Table 3. Weather Stations Used by LANL for Fire Danger Monitoring.

State	Name	Agency	Lat	Long	Elev	Ness ID	National Weather Service ID	NFDRS	FWF zone
NM	Tower	NPS	35:50:00	106:20:00	6500	FA6362DE	290801	326	102
NM	TA-6	LANL	35:51:41.1	106:19:8.4	7424	NA	NA	NA	NA

4.1.4.2 National Fire Danger Rating System

LANL issues a fire danger estimate once a day during the fire season based on the National Fire Danger Rating System (NFDRS). Fire danger estimates are based on an assumed Fuel Model 2 for LANL. The fire danger level is posted daily at the top of the LANL homepage, and can be emailed to anyone who requests to be on the email list. All field crews are required to have two forms of communication (radios, pagers, cell phones). Specific communication procedures are managed through Groups.

The energy release component (ERC) and 1000-hour fuel moisture levels are used to monitor trends. The Southwest Coordinating Center uses a five-day average of the ERC derived from representative fire weather stations throughout the area to monitor fuel conditions and burning characteristics. The following criteria are used in issuing and rescinding wildfire alerts (which trigger special orders and closures):

- regional preparedness levels as determined by the Southwest Coordinating Center,
- current and long-range forecasted weather,

- local ERC value trends (90th percentile threshold), and
- fire suppression resource availability.

4.2 Wildland Fire Suppression

4.2.1 Range of Potential Behavior

Although rainfall for the 2005 water year (Oct. 2004 through Sept. 2005) is above average, the Los Alamos region has been experiencing a severe multi-year drought, which has made fire conditions more extreme than normally experienced. LANL precipitation records (Figure 3) show that six of the past 10 water years (Oct.–Sept.) have been below the 58-year mean (18.11 in.). The last major drought in the area was in the 1950s when only three water years in a 10-year period (1947–1956) were above the mean. The 1950s drought was also marked by significant regional tree mortality (Allen and Breshears 1998).

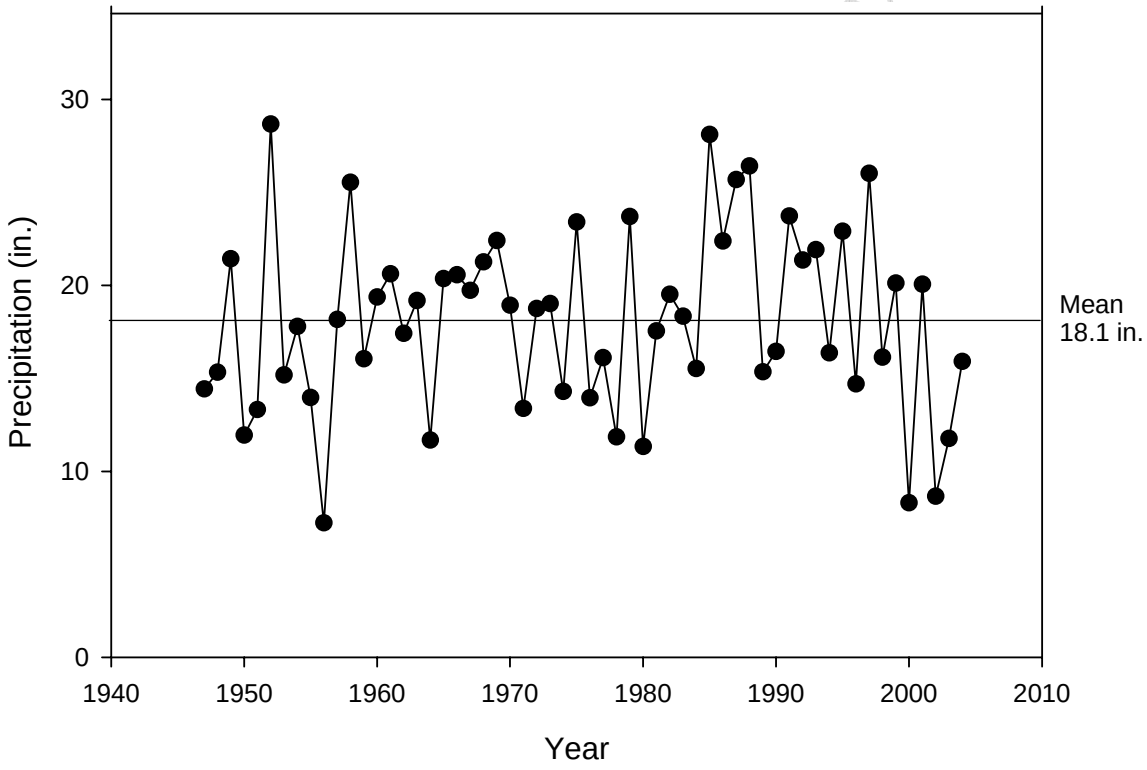


Figure 3. Los Alamos annual precipitation by water year (Oct.–Sept.).

The NFDRS indices are used to communicate wildfire risk. The ERC is one of the indices used at LANL. The ERC is a NFDRS index related to how hot a fire could burn. It is directly related to the 24-hr, potential worst case, total available energy (BTUs) per unit area (ft^2) within the flaming front at the head of a fire (USFS 2004). Figure 4 shows the maximum (red line), average (gray line), 2002 (green line), 2003 (yellow line), and 2005 (blue line) ERC values recorded from the meteorological tower at Bandelier National Monument (date of chart 7/15/05).

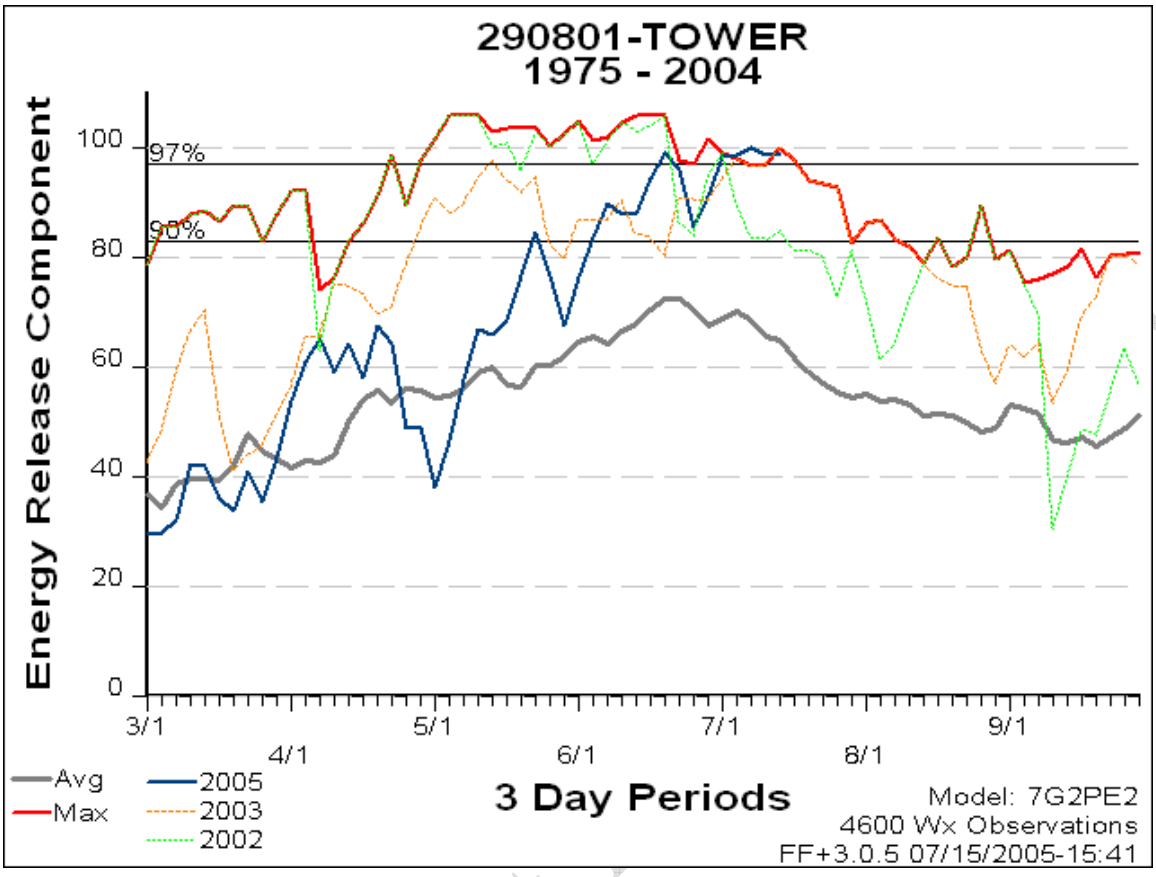


Figure 4. Seasonal trends in ERC for the LANL region. Data from the Southwest Area Wildland Fire Operations Website.

The 90 and 97 percentiles essentially equate to very high and extreme fire danger ratings, respectively. On average (gray line), the fire danger rating does not exceed the very high rating. However, the fire danger has exceeded the very high rating any time between March 1st and September 1st (red line). In 2003 (yellow line), the ERC scores exceeded the very high rating from the end of April through mid August. The year 2004 (not shown) was less severe overall, although the fire danger was extreme from mid May through mid June. Earlier reports forecasted 2005 ERC scores to be substantially lower than those reported for 2003 or 2004. Following a particularly wet winter and spring, 2005 ERC scores started out low but were setting records by late June, early July. The Santa Fe National Forest Fire Management Plan (SFNF 2005) reports that most large fires on the forest (120+ ha/300+ acres) occurred when the ERC was above the 65th percentile, while the most severe fires occurred at or above the 90th percentile.

Other drought-related issues have an effect on regional wildfire risk. Extensive bark beetle-induced tree mortality has been recorded throughout the southwestern United States, roughly coincident with the extent of the drought. Multiple species of bark beetle are involved in attacking several species of trees. Mortality estimates (Balice 2004) at LANL range from 97 percent mortality of piñon greater than 3 m (10 ft) tall in unthinned piñon-juniper woodland, 14 percent mortality of ponderosa pine greater than 3 m (10 ft)

tall in unthinned ponderosa pine forest, and 96 percent mortality of ponderosa pine, Douglas-fir, and white fir greater than 3 m (10 ft) tall in unthinned mixed conifer forest. Standing dead trees with dead needles are considered a significantly greater fire hazard than live trees or dead trees without needles. In general, piñon, Douglas-fir, and white fir trees appear to lose their needles in less than a year while ponderosa pine can retain dead needles for many years, thus the threat may be greater in the mid elevational range occupied by ponderosa pine. Due to the extent of the tree mortality in the LANL area, little additional bark beetle activity is expected in the piñon-juniper woodland. However, bark beetle-induced mortality could be substantial in the ponderosa pine and mixed conifer forest west of Los Alamos.

4.2.2 Initial Attack

Initial attack refers to the actions taken by the first resources to arrive at a wildfire to protect lives and property and prevent further expansion of the fire. Initial attack is an aggressive suppression action consistent with firefighter and public safety and with values to be protected. Wildland fire will be aggressively suppressed when it occurs on LANL property. LAFD will cooperate to suppress wildfires that ignite off of LANL property, but that threaten or potentially threaten LANL property (Table 4).

Table 4. Organizations Responsible for Initial Attack.

Lead Organizations	Roles and Responsibilities
LAFD	Conduct initial attack on wildland fire originating on LANL or threatening LANL.
EM&R	Maintain information sources for conducting initial fire assessment. Analyze wildland fire situation complexity, develop a Unified Incident Command, and request additional interagency resources if required.

Initial attack resources available from the LAFD increase from a minimum of 28 to a minimum of 31 personnel under Extreme fire danger conditions. Incident commanders are aware of fire danger conditions. Incident commanders are responsible for evaluating the complexity of an incident and requesting additional resources from the Santa Fe Zone Coordinating Group when conditions warrant.

4.2.2.1 Information Used To Set Initial Attack Priorities

Much of the information needed to set initial attack priorities is available through geographic information systems databases maintained at the Emergency Operations Center (EOC) and through information LAFD maintains concerning facility hazards. Information that may be used for completing an initial fire assessment include the following:

- FMZ (defensible space, steep canyon, general forest area)
- Access (fire roads and fire breaks)
- Topography
- Fire danger ratings
- Size of fire

- Mission critical facilities
- Potential release site locations
- Material disposal area locations
- Nearby facilities and hazardous materials inside facilities
- Threatened and endangered species habitat map
- Archaeological site locations

Although there is no formal process, emergency response personnel from EM&R and LAFD communicate to set initial attack priorities and appropriate response.

4.2.2.2 Criteria for the Appropriate Initial Attack Response

There is no official procedure for determining the level of response for initial attack at LANL. EM&R and LAFD personnel determine initial attack priorities and level of response using the criteria listed under initial attack priorities.

4.2.2.3 Response Times

The *LAFD Standards of Response Coverage* (LAFD 2005) outlines the coverage standards for various emergency responses to LANL facilities. This document establishes all response time objectives regardless of time of year. For purposes of fire suppression response times, the objective is to meet or exceed the goals set forth in DOE Order 440.1, *Worker Protection Management for DOE Federal and Contractor Employee*, with respect to actual travel time to a site or facility. The agreed upon criteria for response to LANL facilities have been established as 5 minutes or less 90% of the time for a first due company, and 10 minutes or less 90% of the time for a full first alarm response when such a response is warranted (LAFD 2005). Deviations to response times include exceptional delays to access of secure facilities in order to follow national security/safety protocols.

LANL has a fire road network to facilitate access and reduce response times to undeveloped areas of the Laboratory (Figure 5). Fire road specifications were developed (URS 2002) and roads were upgraded as part of a special allocation associated with the CGRP. The primary responsibility for implementing fire road maintenance will be assumed by PM-IP with funding assistance from facilities. EM&R and ENV-WQH will monitor fire roads and prescribe required maintenance.

The isolated location, rugged terrain, and the almost total absence of significantly sized communities between Los Alamos and Santa Fe (the nearest city) make mutual aid firefighting forces unavailable for short-term assistance. In an emergency, LANL and Los Alamos County essentially are dependent on their own resources for a significant time period (Tomecek et al. 2003). A Type 1 Incident Management Team (for large, complex incidents such as the Cerro Grande Fire) requested through the Santa Fe Zone Coordinating Group will respond in no less than 48 hours, a Type 2 team (intermediate complexity) can respond within 24 hours.

4.2.3 Extended Attack

Extended attack includes the implementation of operational plans through actions taken to respond to wildland fire that is not controlled by initial attack (Table 5). Neither

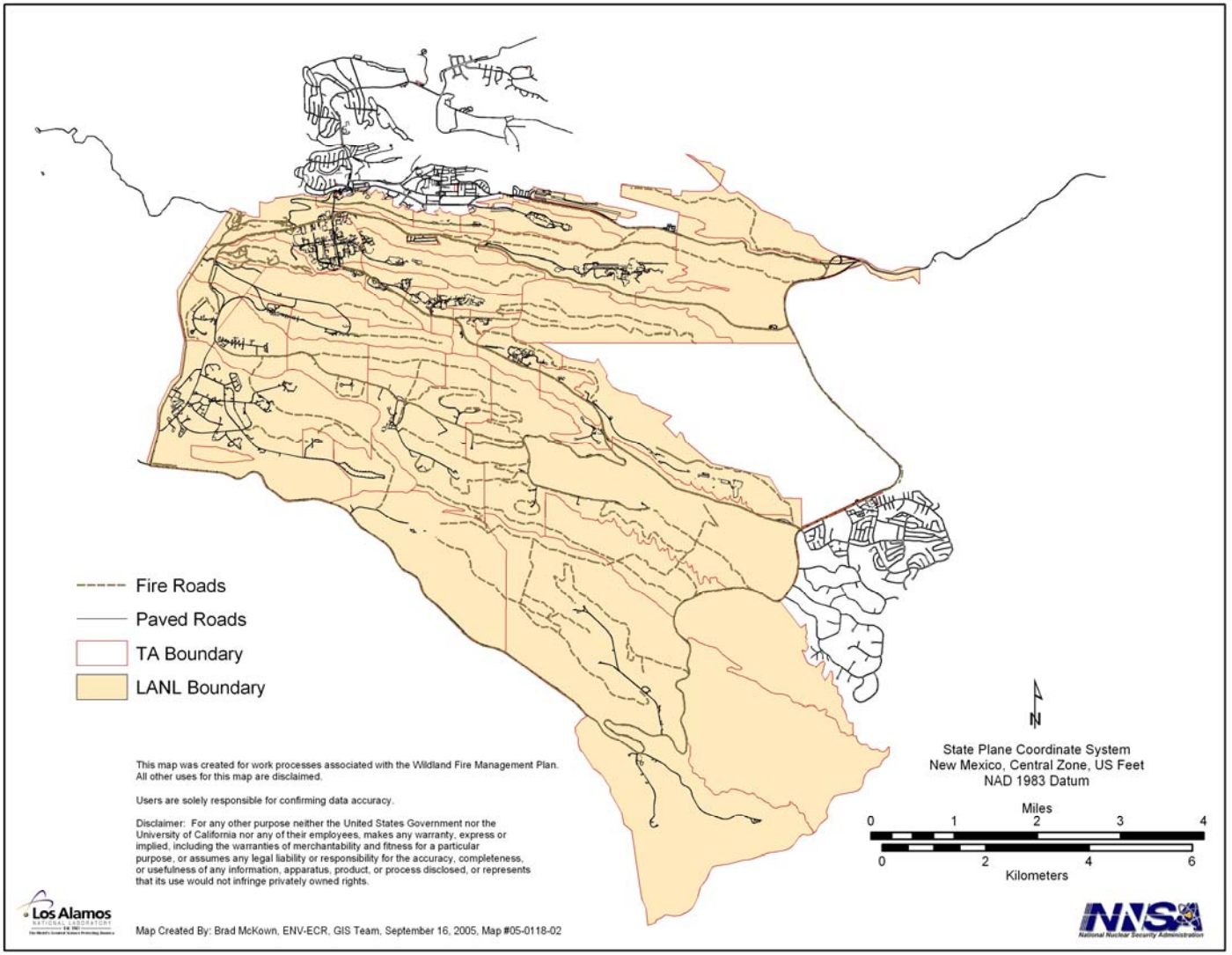


Figure 5. LANL fire roads.

Table 5. Organizations Responsible for Extended Attack.

Lead Organizations	Roles and Responsibilities
LANL ADSFO	A wildland fire requiring extended attack could potentially be considered a site emergency. The ADSFO is responsible for Laboratory operations during an emergency.
SWCC (Santa Fe Zone)	Dispatches interagency wildland firefighting resources upon request, including a qualified Incident Command team based on the complexity of the incident.
LAFD	Support for extended attack on wildland fire, provide structural protection, and participate in the Unified Incident Command.
EM&R	Continue contractor, internal, and interagency coordination during firefighting operations. Staff the Emergency Operations Center. Provide information on site hazards and potential hazards resulting from the wildland fire.

LANL nor LAFD currently support fire staff personnel that are qualified to manage Type 3 or higher incidents (extended attack on wildland fire). In cases where a wildfire is judged or anticipated to require more than initial attack suppression activities (Type 3 or higher) by the Incident Commander, the Santa Fe Zone Coordinating Group is contacted for wildland firefighting resources. LANL and LAFD staff would then participate in a Unified Command with a responding interagency Incident Command Team. For fires on DOE property, EM&R is preauthorized to use unbudgeted funds to respond to wildland fire as needed.

4.2.4 Minimum Impact Suppression Tactics (MIST) Requirements

It is LAFD policy to use MIST whenever and wherever possible, at the discretion of the incident commander. The decision to use MIST must take into account firefighter safety and values at risk, particularly the risk of wildland fire traveling into the Defensible Space Zone (FMZ 1) or across LANL boundaries. The use of MIST is strongly encouraged when around hazardous materials and archeological sites and in threatened and endangered species habitats. A list of MIST from the *Incident Response Pocket Guide* (IOSWT 2002) is included in Appendix 2.

4.2.5 Other Fire Suppression Considerations

4.2.5.1 Health Effects Monitoring

During wildland fire, there is concern about harmful health effects, either from the natural qualities of fire and smoke or from release of anthropogenic contaminants in air or water. LANL staff (Table 6) will monitor air and water quality to estimate and mitigate adverse effects, if possible. ENV-MAQ maintains three particulate matter-monitoring locations in Los Alamos County, which continuously monitor ambient air concentrations of two different sizes of particulate matter (less than 2.5 um and greater than 10 um). The data from these samplers are regularly posted to the ENV-MAQ website. Additional samplers are calibrated and in the field should additional samples be needed during a fire or other emergency.

Table 6. Organizations Responsible for Health Effects Monitoring.

Lead Organizations	Roles and Responsibilities
ENV-MAQ	Provide real-time meteorological data and weather forecasting support for fire behavior modeling. Monitor air quality effects. Particulate matter monitoring.
ENV-WQH	Monitor water quality effects in surface waters, sediments, and ground water.
HSR Division	Health physics and industrial hygiene.

The Health, Safety, and Radiation Protection (HSR) Division is responsible for securing LANL buildings and protecting LANL workers while operations are standing down, providing dosimeters to selected firefighters if deemed necessary, and health physics/industrial hygiene support for personnel performing contaminant monitoring of wildland fire. During the Cerro Grande Fire, HSR Division personnel held briefings and presented sampling data to address concerns of visiting firefighters.

4.2.5.2 Hazardous Materials

Information on hazardous materials storage and disposal sites is available to firefighters as a component of the geographic information system database used to set initial attack priorities. If the EOC is activated, the Emergency Technical Support Center will have personnel familiar with hazardous materials issues. MIST will be utilized to prevent the potential release and exposure of hazardous materials.

4.2.5.3 Explosive Areas

LANL experimental explosives testing can result in fire starts, however, they very rarely progress into wildland fires. Explosive testing sites have been identified as high-priority sites for prescribed fire fuels-reduction treatments. The DX wildfire risk assessment procedure is described in Section 4.1.1.4.

4.2.5.4 Mission Critical Facilities

Information on mission critical facilities is available to firefighters as a component of the geographic information system database used to set initial attack priorities. If the EOC is activated, the Emergency Technical Support Center will have personnel familiar with these facilities. All mission critical facilities were identified and received defensible space thinning treatments as part of the CGRP. These facilities will maintain a high priority for preparedness, suppression, and mitigation activities.

4.3 Prescribed Fire

4.3.1 Planning and Documentation

LANL staff will participate in annual prescribed fire planning sessions through the IWMT. LANL staff will identify and prioritize potential prescribed fire projects, address funding, compliance and logistical issues, and collaborate with the United States Forest Service or National Park Service for implementation. The process of identifying projects

and acquiring funding for planning and implementation will likely require at least two years.

Fire managers and fuels reduction specialists at LANL have identified pile burning as a needed tool for slash management in secure or contaminated areas of LANL and broadcast burning as a needed tool for surface fuel load reduction. Pile burning and broadcast burning, in combination with thinning and slash removal, form a suite of complementary methods for reducing fuel levels and maintaining fuels at acceptable levels. After thinning has been accomplished, burning may be the most cost-effective method for eliminating certain types of unwanted fuels and thinning slash, and for maintaining acceptably low fuel loads over large portions of LANL.

Prescribed fire will be used primarily to control fuels on firing sites and in General Forest areas. Potential burn units were determined by the IWMT and are displayed in Figure 6.

A prescribed fire may be implemented only with trained and qualified personnel. No less than the organization described in the approved Prescribed Fire Burn Plan (RxBP) may be used to implement the project. The size and complexity of each prescribed fire will determine the personnel needed to safely achieve the objectives of the project. Workforce and equipment needs should be coordinated to ensure that fire use and contingency actions do not exceed site capabilities and are coordinated with mutual aid responders.

Prescribed fires will be implemented and managed by trained personnel from the National Park Service or United States Forest Service. Bandelier National Monument requires that all prescribed fires be managed by a qualified burn boss (Level 1 or 2). Desired staffing for prescribed fire implementation includes

- one Prescribed Fire Manager
- one to two Prescribed Fire Burn Bosses (at least level 2)
- two Holding/Ignition Specialists
- four Fire Monitors

LANL and LAFD will provide escorts, subject matter experts, and onsite firefighting personnel and equipment support. All proposals and decisions to use prescribed fire are subject to site analysis, documentation, and disclosure requirements for complying with the National Environmental Policy Act. All prescribed fire projects will require a RxBP.

The *Environment Assessment for Wildfire Hazard Reduction and Forest Health Improvement Program*, Burn Alternative (DOE 2000) emphasizes a number of engineering and administrative controls to be implemented as a part of a prescribed fire project. These controls include a Facility and Forest Fire Hazard Assessment, identification of resource issues, coordination with neighboring land management agencies and land owners, conducting the actions consistent with applicable open burn permit conditions, development of end-state conditions, formulation of treatment and environmental protection measures; the use of worker protection and health and safety measures tailored to each project; the use of hand tools to remove vegetation from cultural resource sites; the use of non-sparking equipment during periods of extreme fire

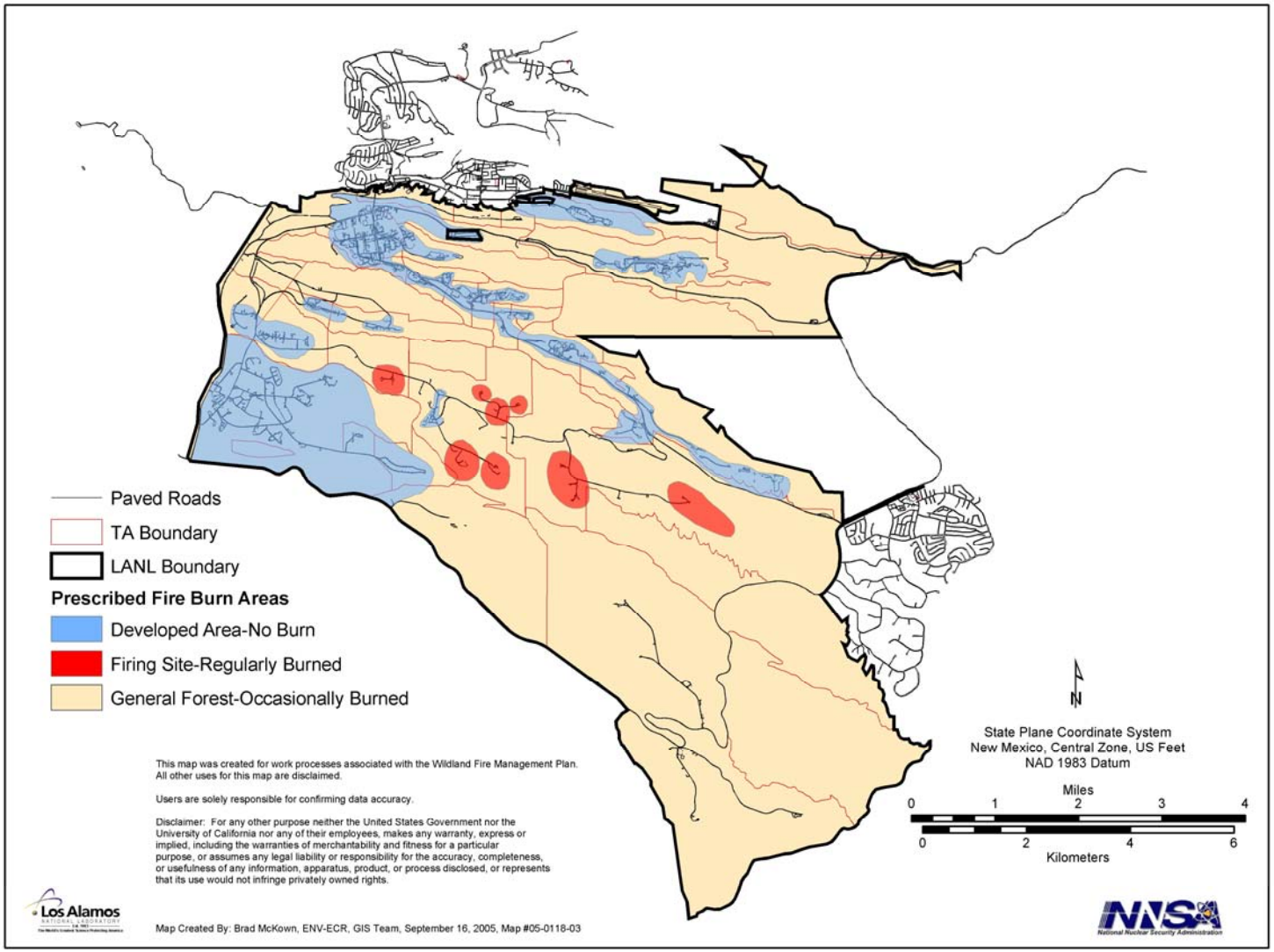


Figure 6. Potential prescribed fire use areas.

danger; and the use of best management practices to prevent surface soil erosion and sediment migration controls where soil disturbances are unavoidable. These controls will be documented in project-specific RxBPs.

Temperature, relative humidity, wind speed and direction, and fuel moisture will all be monitored before and during prescribed fire implementation. The RxBP will require site-specific smoke/plume and wildfire behavior modeling for environmental conditions within the prescription. Fire behavior and fire effects characteristics such as rate of spread, flame length, smoke dispersal, and scorch height will be monitored throughout the prescribed fire. Consideration will be given to long-term drought conditions such as lack of winter snow pack, long-term rainfall deficit, delayed green up, low fuel moistures, long-range weather forecasts, and other identified drought trends.

All areas treated with prescribed fire will be incorporated into the existing LANL wildfire hazards monitoring program for evaluation of short- and long-term effectiveness. The monitoring program (described in Section 4.6) will quantify the reduction in wildfire fuel levels. These data will then be incorporated into the EOC Wildfire Hazards Assessment model database. Specific evaluation criteria will be contained within the individual RxBP.

Each prescribed fire will receive a post-burn evaluation. The format for the evaluation will be contained within the RxBP. After completion of a prescribed fire, participating personnel will review the fire and elements contained in the burn plan, complete any monitoring and evaluation requirements, then evaluate the fire. The objective will be to understand and improve prescribed fire techniques, operations, prescriptions, and the fire effects. A presentation of the evaluation will be made to the IWMT.

ENV-ECO maintains geographic information system coverages for thinned areas, areas burned in the Cerro Grande Fire, and areas that received rehabilitation treatments following the fire and/or thinning treatments. These coverages are available upon request for planning and implementation purposes.

A RxBP, meeting interagency requirements, including the use of fire complexity, will be prepared and approved before prescribed fire ignition. A decision to amend a RxBP requires approval at the same or a higher level of authority as required to approve the initial plan.

4.3.2 Prescribed Fire Escape

In addition to the trained agency personnel conducting the prescribed burn, LAFD support will be on site during all prescribed burn activities and escapes will be aggressively suppressed. A prescribed fire should be designated a wildland fire when it exceeds, or is anticipated to exceed, one or more prescription parameters delineated in the fire's documented burn plan and cannot be brought back to within prescription within 48 hours. Once a prescribed fire has been declared a wildland fire, it may not be redesignated as prescribed fire. In the unlikely event that a prescribed burn becomes a wildland fire, additional suppression resources will be requested through the Santa Fe Zone Coordinating Group.

4.3.3 Air Quality and Smoke Management

The only Class I airshed that is likely to be impacted by a prescribed fire program at LANL is over Bandelier National Monument. Fortunately, the prevailing winds will generally carry smoke away from the Bandelier airshed. Other pre-identified smoke sensitive areas would include Los Alamos, White Rock, and, potentially, Santa Fe.

LANL must comply with the requirements of the New Mexico Smoke Management Regulation (20.2.65 NMAC). Compliance with 20.2.65 NMAC also assures compliance with the Federal Clean Air Act and the Regional Haze Rule (40 CFR 51.309). The New Mexico Environment Department, Air Quality Bureau establishes and regulates smoke management policy for the state (2003b). The New Mexico Environment Department Smoke Management Program is depicted graphically in Figure 7. Burning vegetation on less than 10 acres (4 ha) or 1000 cu ft pile volume per day falls under the open burning regulation. Larger burns (>10 acres/4 ha) must be registered with the State and must meet more stringent requirements. ENV-MAQ will be the point of contact with the State for all air quality issues.

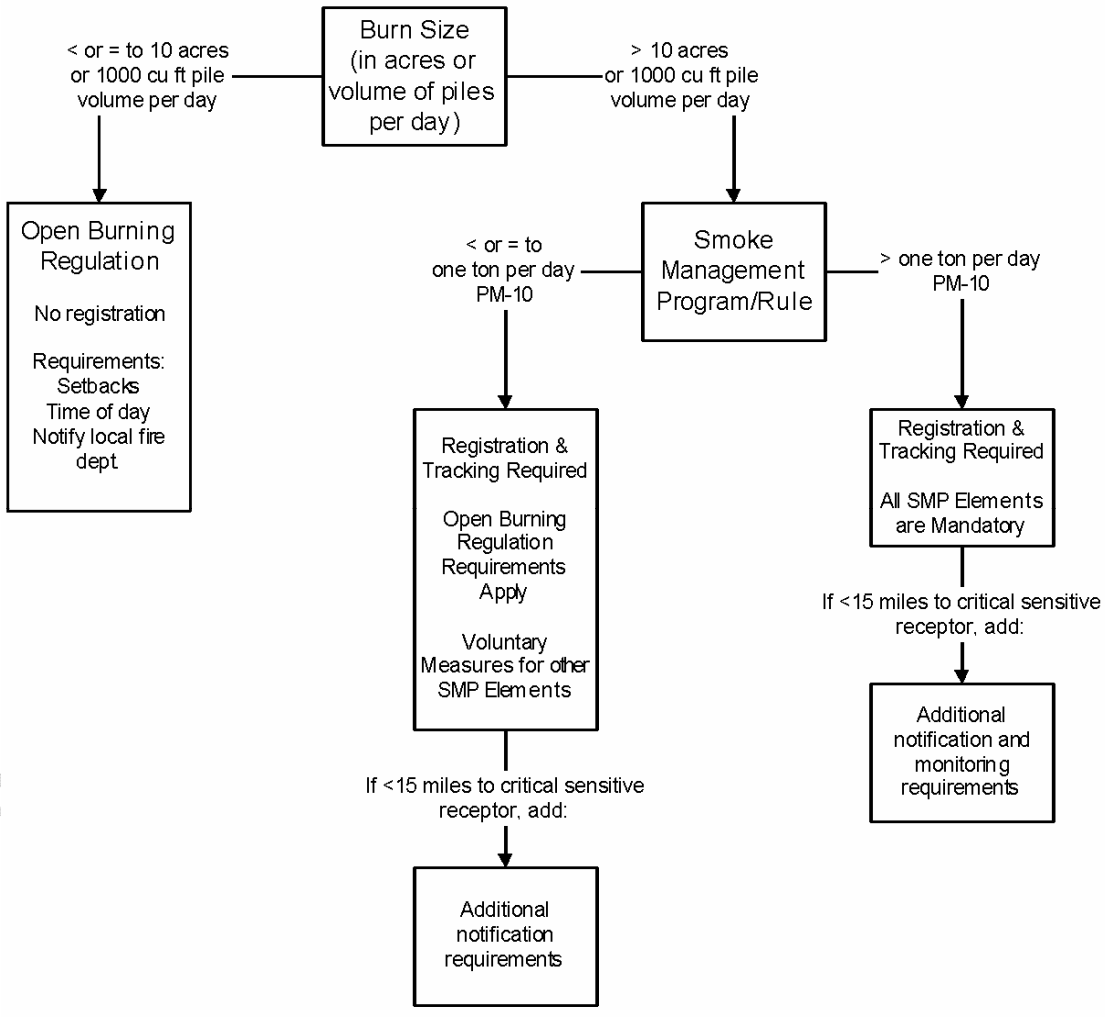


Figure 7. New Mexico Environment Department Smoke Management Program Flow Chart.

4.3.4 Hazardous Materials

Project-specific potentially hazardous materials will be identified in the RxBP. Potentially adverse health effects will be avoided or mitigated. Health effects mitigation and monitoring support is available through the HSR Division.

4.4 Non-Fire Fuels Reduction

Non-fire fuels reduction is the primary means of fuels reduction at LANL and includes all fire hazard reduction activities other than prescribed fire. The primary means of fuels reduction currently in use at LANL are forest thinning and slash removal, mastication, and mowing. Over 7,200 acres (2,900 ha) have been thinned since the Cerro Grande Fire (Figure 8). Non-fire fuels reduction priorities will be determined in part through meetings of the IWMT or a subcommittee. Facility managers can also bring concerns to the attention of wildfire management personnel. There are several entities at LANL involved in planning and implementing these activities (Table 7).

Table 7. Organizations Involved in Non-Fire Fuels Reduction and Fire Road Maintenance.

Lead Organizations	Roles and Responsibilities
EO-FIRE	Plans, assesses, and monitors fuels treatments in the defensible space zone (FMZ 1).
FMD-UI	Plans, conducts, and monitors vegetation thinning activities along utility corridors (FMZ 1).
PM-IP	Collaborates with other LANL organizations to develop prescriptions for defensible space (FMZ 1) and general forest treatments to reduce wildland fire hazard (FMZ 2 and FMZ 3). Implement forest thinning projects, including site preparation, contract administration, subcontractor oversight, waste disposal, and site rehabilitation. Conducts fire road maintenance.
ENV-ECO	Assesses wildland fire risk, fuels treatment effectiveness, rehabilitation responses, and cost-effectiveness of management activities through forest and fuel monitoring and fuels and fire behavior modeling (FMZ 2 and FMZ 3). With PM-IP, develop prescriptions for general forest treatments to reduce wildland fire hazard. Provide support for legal and regulatory compliance for fire management activities, including National Environmental Policy Act, threatened and endangered species, and cultural resources.
ENV-WQH	Provide support for legal and regulatory compliance for fire management activities and fire road maintenance, including administering stormwater pollution prevention permits for non-silvicultural activities disturbing >1 acre of land. Provide best management practices for site rehabilitation after disturbance from fire management activities. Assess implementation of best management practices.
ENV-MAQ	Provide support for legal and regulatory compliance for fire management activities, including administering air quality permits for prescribed burning and waste disposal activities. Provide climatic and site-specific data for wildland fire behavior and risk modeling.

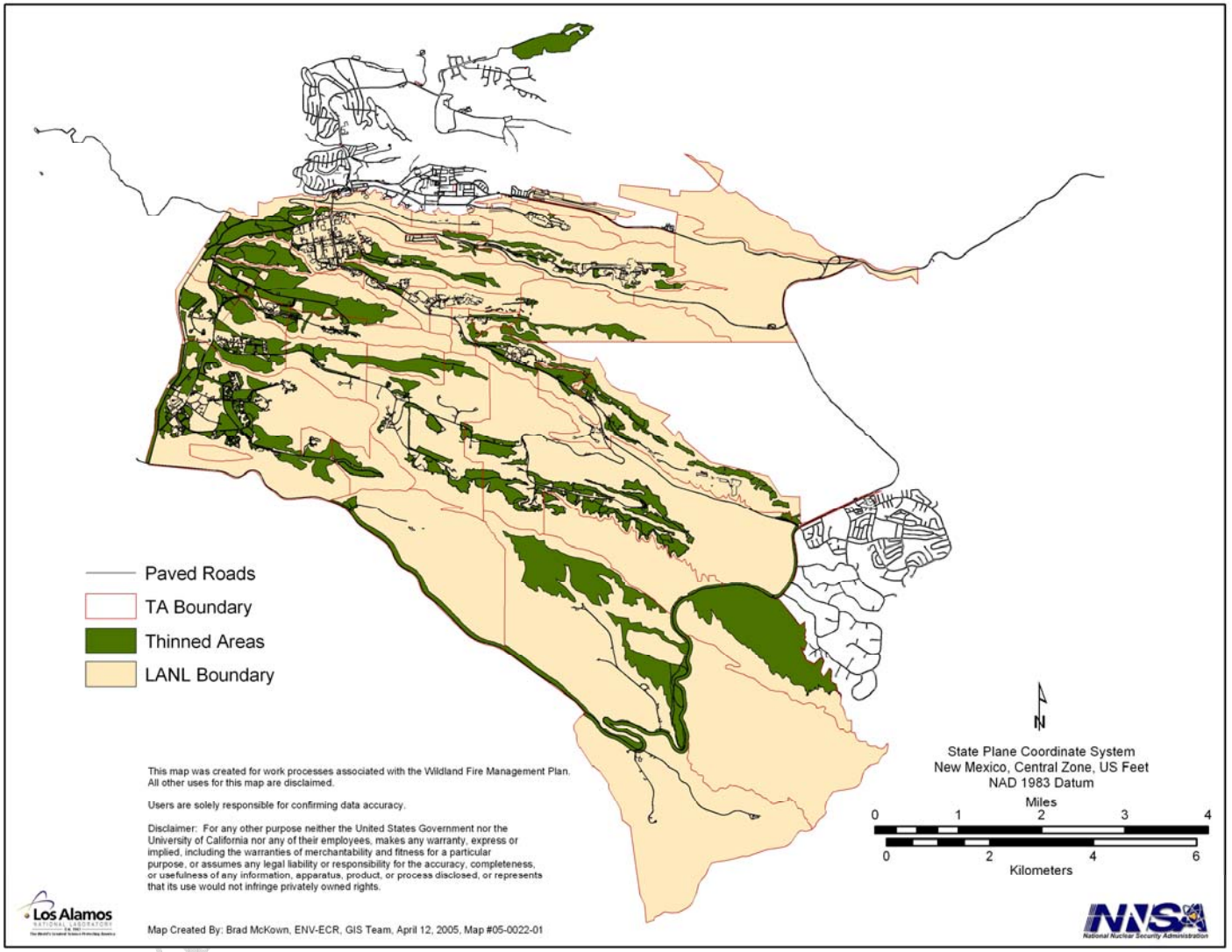


Figure 8. LANL thinned areas.

Pretreatment planning requires a site-specific project plan, which will then be reviewed by the environmental groups (ENV-ECO, -MAQ, and -WQH) for environmental concerns. Projects must meet the requirements of the Site and Project Planning LIR (LANL 2004c), which includes participation in the LANL Permits and Requirements Identification Process for additional compliance review. In general, non-fire fuels reduction activities are conducted through subcontractors. Integrated Projects (PM-IP, formerly FWO-IP) will be responsible for subcontractor oversight, training, and access control.

4.4.1 Annual Activities

Fuels treatments are used to reduce the risk of crown fire on LANL property. Fuels treatments include mechanical maintenance of defensible space and fuel breaks around facilities, roads, and infrastructure, mechanical thinning of selected forested stands, and mechanical and chemical treatment of shrubs, particularly in fuel breaks and defensible space. All slash created during mechanical thinning operations will be removed from the site and burned or disposed of.

See Section 5.0 for a discussion of future activities.

4.4.2 Equipment and Seasonal Use Restrictions

Vehicular thinning equipment is not allowed to operate on slopes greater than 30 percent because of the high erosion potential (LANL 2001b). All fuels treatment operations must follow the guidelines of LANL's *Threatened and Endangered Species Habitat Management Plan* and the WHRP (LANL 2001a). Cultural resource sites will be protected as described in the WHRP.

4.5 Emergency Rehabilitation and Restoration

As a response to the Cerro Grande Fire, LANL staff developed procedures for burned area rehabilitation. Assessments of those rehabilitation efforts are still ongoing and may result in modification of techniques for future wildland fires. Descriptions of burned area rehabilitation techniques are included in the following documents:

- LA-UR-00-3767, *Cerro Grande Fire: Aftermath Activities to Reduce the Potential Movement of Contamination at Potential Release Sites* (LANL 2000a).
- LA-UR-00-3085, *Los Alamos National Laboratory Emergency Rehabilitation Project Plan* (LANL 2000b).
- LA-UR-02-4921, *Progress Report on Los Alamos National Laboratory Cerro Grande Fire Rehabilitation Activities One Year After Burned Area Rehabilitation* (LANL 2002a).
- LA-UR-03-5196, *Progress Report on Los Alamos National Laboratory Cerro Grande Fire Rehabilitation Activities: Status of Burned Area Rehabilitation Two Years Postfire* (LANL 2003b).
- LA-UR-03-7139, *Progress Report on Los Alamos National Laboratory Cerro Grande Fire Rehabilitation Activities* (LANL 2003c).

LANL has staff trained in BAER techniques (Table 8). Following the Cerro Grande Fire of 2000, LANL staff and contractors treated over 1,800 acres (728 ha) using rehabilitation techniques similar to those used by the BAER Team (Figure 9). In general, burned sites were evaluated for erosion potential, rehabilitation treatments were prescribed, and treatments were implemented by contract personnel under the supervision of ENV-WQH. ENV-WQH and ENV-ECO have developed a modified Universal Soil Loss Equation to model potential soil loss from disturbed sites. This model can be used to estimate potential soil loss and prioritize areas for treatment.

Table 8. Groups Responsible for Burned Area Rehabilitation.

Lead Organizations	Roles and Responsibilities
ENV-ECO	Assess and stabilize cultural resources sites damaged by wildland fire.
ENV-WQH	Assess and rehabilitate lands damaged by wildland fire. Assess potential damage resulting from post-fire flooding and recommend rehabilitation actions.
Environmental Characterization and Remediation	Assess and rehabilitate areas to reduce potential movement of contaminants.
PM-IP	Implement erosion control for roads and facilities.

Future burned area emergency rehabilitation would follow a similar procedure of assessment of damage, treatment prescription, treatment implementation, and treatment monitoring and maintenance.

4.6 Monitoring and Evaluation

4.6.1 Wildfire Hazard Monitoring

Fire hazard monitoring is required to evaluate the technical and economic effectiveness of our management actions. These data are used in conjunction with fire behavior and forest growth modeling techniques to compare the current wildfire hazards to target conditions. The results of this monitoring and evaluation will be used to recommend optimal management actions and ensure cost-effectiveness of treatments. The monitoring data are also used to update the EOC Wildfire Hazards Assessment model, which is used in emergency situations to forecast wildfire behavior and make more informed decisions on suppression and evacuation.

The wildfire hazards monitoring procedures are described in Balice (2005). Vegetation and fuels are monitored within 60- by 60-m (196- by 196-ft) permanent plots. Approximately 200 plots have been established throughout the different land cover types associated with LANL. Each year a small number of new plots are established and a subset of the original plots are resampled. All plots are sampled on a roughly five-year rotation. This sampling design reduces costs but remains flexible enough to respond to changing conditions. Wildfire hazards monitoring, database management, and hazard assessment modeling will be conducted through ENV-ECO.

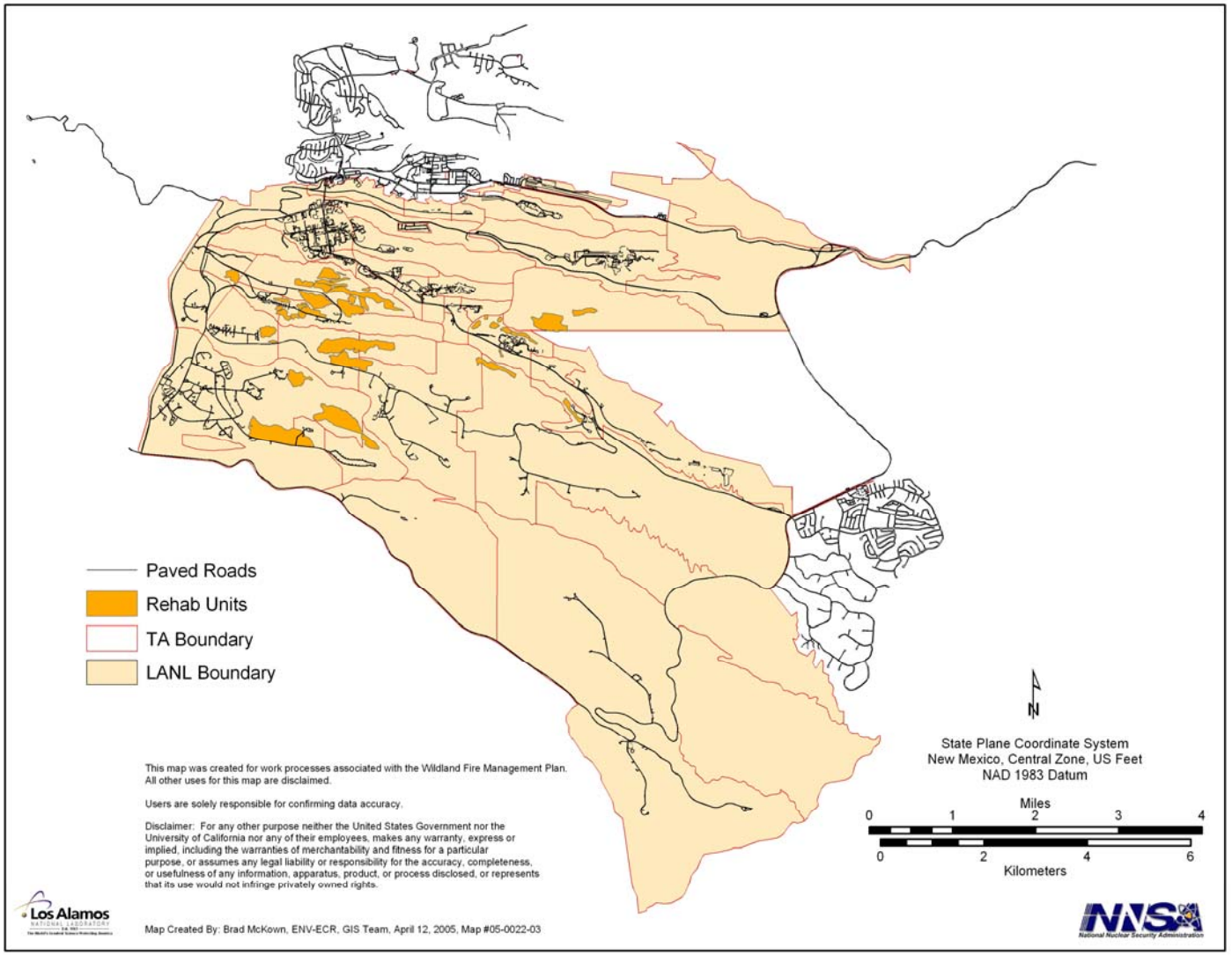


Figure 9. Fire rehab units.

4.6.2 National Fire Incident Report System

LAFD documents every fire response. The information is maintained using "FireHouse" software and submitted annually to the New Mexico State Fire Marshal, who then forwards the information to US Fire Association (USFA) to be entered into the National Database.

The National Fire Incident Report System (NFIRS) reporting format is based on the NFPA Standard 901, *Uniform Coding for Fire Protection*, 1976 version, the 1981 codes for Fire Service Casualty Reporting, and the 1990 codes for Hazardous Materials Reporting. The current version of NFIRS, version 5.0, was released in January 1999. NFIRS 5.0 expands the collection of data beyond fires to include the full range of fire department activity on a national scale. It is a true all-incident reporting system.

Participating local fire departments fill out the Incident and Casualty reports as fires occur. They forward the completed incidents via paper forms, computer media, or the Internet to their state office where the data are validated and consolidated into a single computerized database. Feedback reports are generated and forwarded to the participating fire departments. Periodically, computer media containing the aggregated statewide data is sent to the National Fire Data Center at the USFA to be included in the National Database. This database is used to answer questions about the nature and causes of injuries, deaths, and property loss resulting from fires. The information is disseminated through a variety of means to states and other organizations. The NFIRS is a model of successful Federal, State, and local partnership. The database constitutes the world's largest national annual collection of incident information.

4.6.3 Other Monitoring and Reporting Activities

ENV-WQH and ENV-ECO will complete an assessment of areas rehabilitated after the Cerro Grande Fire on the soil erosion potential and recommended follow-up treatments for preservation of water quality and ecosystem health based on lessons learned during the CGRP. A report on the findings will be published, by the end of FY05, as a component of the Special Environmental Assessment Mitigation Action Plan Annual Report.

5.0 Organization and Budget

5.1 Proposed Organization

LANL organizations have been working together for the past four years to reduce wildfire risk. The management structure described herein will maintain many of the roles and responsibilities that were established during the CGRP effort (Table 9). Figure 10 shows the relationship of internal organizations involved in the Wildland Fire Management Program. Long-term budget forecasts are described in Section 5.4.

Table 9. Proposed Organizational Roles and Responsibilities for the Wildland Fire Management Program.

Responsible Organization	Roles and Responsibilities	Contacts
LAFD	Wildfire Preparedness Emergency Response Initial Attack Extended Attack	Douglas Tucker, LAFD 662-8309, dtucker@lanl.gov
EM&R	Wildfire Preparedness Emergency Response Initial Attack Extended Attack	Gene Darling, EM&R 667-6211, em3@lanl.gov Manuel L'Esperance EM&R 667-6211, mannyl@lanl.gov
EO-FIRE	Risk Assessment Defensible Space Maintenance	Jim Streit, EO-FIRE Group Lead 667-9045, jstreit@lanl.gov
PM-IP	Risk Assessment Fuels Reduction Treatments Rehabilitation Fire Road Maintenance	Jim Jones, PM-IP Group Lead 665-0144, jjones@lanl.gov
FMD-UI	Utility Corridor Maintenance Fire Road Maintenance	Dave Padilla, FMD-UI Group Lead 667-2408, allidap@lanl.gov
ENV-ECO	Risk Assessment/Modeling Fuels and Fire Hazard Monitoring Compliance Monitoring Rehabilitation Monitoring	Sam Loftin, Forestry Project Lead 665-8011, sloftin@lanl.gov Randy Balice, Principal Investigator 665-1270, balice@lanl.gov
ENV-WQH	Compliance Monitoring Rehabilitation Monitoring	Kevin Buckley, Hydrologist 667-1454, kbuckley@lanl.gov
ENV-MAQ	Compliance Monitoring	Jackie Hurtle, Smoke Mgmt 665-4380, jhurtle@lanl.gov
SSMO	Integrated Land and Resource Management Planning	Carey Bare 667-3349, cbare@lanl.gov

Wildland fire management activities were traditionally managed under the Associate Directorate for Operations (ADO). Since the reorganization of ADO, these activities will be split between the ADSFO and the Associate Directorate for Technical Services (ADTS). LAFD, a DOE/NNSA subcontractor, and EM&R share preparedness, response, and initial attack roles and responsibilities. The LAFD contract is administered through LANL Procurement, a designated EM&R contact serves as the Technical Advisor to the contract. If needed, assistance for extended attack will be requested through the Santa Fe Zone Coordinating Group.

Risk monitoring and compliance monitoring will be managed through ENV Division. Activities such as broad-scale wildfire risk assessment, defensible space maintenance, fuels reduction, and rehabilitation are relatively recent activities initiated or expanded, for the most part, as a result of the Cerro Grande Fire. The basic process for wildfire risk reduction developed through the CGRP has worked well. This transitional period should be used to improve collaboration and efficiency and establish long-term institutional procedures and sources of funding.

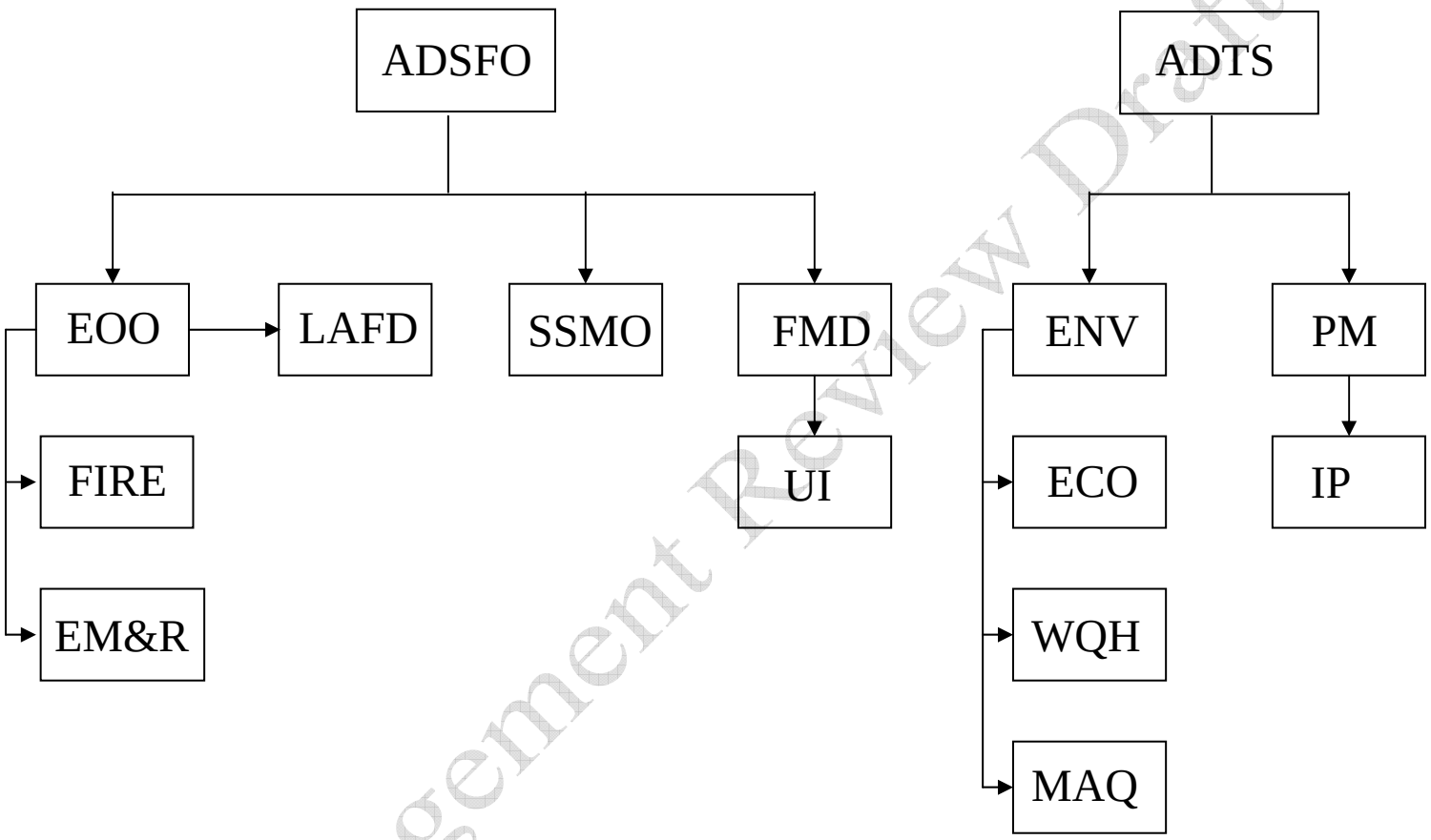


Figure 10. LANL Wildland Fire Management Program Organizational Structure.

5.1.1 ADSFO Activities

The Space and Site Management Office will participate in wildland fire management planning and act to facilitate coordination between Directorates.

PM-IP, formerly FWO-IP, will retain responsibilities for implementing defensible space, firebreak, and general forest wildfire fuels reduction and rehabilitation treatments. PM-IP will also assume the primary responsibility for fire road maintenance.

FMD-UI is responsible for monitoring and managing fire hazards within utility corridors and participates in fire road maintenance activities. EO-FIRE is primarily responsible for structural fire protection. EO-FIRE wildland fire responsibilities include defensible space maintenance. Local subcontractors will generally perform the work. PM-IP will be responsible for managing subcontractors. PM-IP will coordinate with ENV-WQH and ENV-ECO to implement watershed best management practices and rehabilitation procedures when appropriate. Groups will coordinate and follow the Site and Project Planning LIR guidelines to assure environmental compliance for all activities.

5.1.2 ADTS Activities

ENV-ECO will work with other Groups to assess and prioritize the wildfire risk across the LANL site and develop mitigation plans. ENV-ECO has been monitoring wildfire fuels since 1997 and will retain responsibilities for the fuel and fire hazard monitoring and modeling program. Model output is used not only to assess risk and plan fuel mitigation activities but is also used by EM&R for emergency response applications. ENV-ECO will be responsible for revisions to the WFMP and the WFMP Update.

Other ENV organizations involved in wildland fire management include ENV-WQH and ENV-MAQ. ENV-WQH is responsible for implementing and monitoring postfire and post-thinning rehabilitation and for water quality compliance. ENV-MAQ is responsible for air quality monitoring and compliance.

5.2 Current Fiscal Year Budget

Current information on planned activities and budget will be presented in the WFMP Update.

5.3 Long-Term Activities

Members of the IWMT identified and prioritized wildfire mitigation vulnerabilities that need to be addressed. A list of specific projects was generated, as well as a list of assessments that need to be incorporated into a periodic monitoring program. Approximate project boundaries were input into a geographic information system database and are displayed in Figure 11.

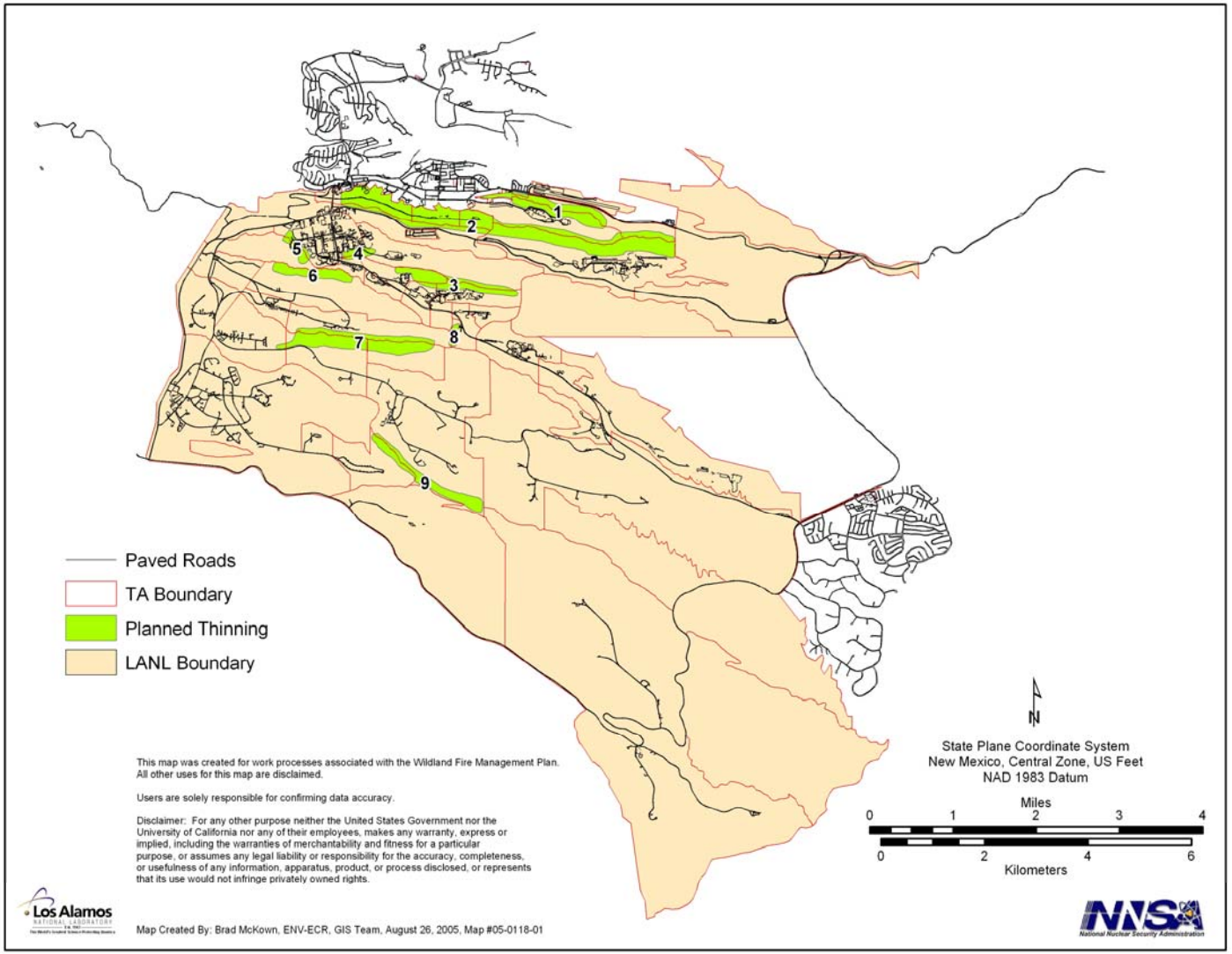


Figure 11. Future thinning projects.

5.3.1 Lab-Wide Assessments of Wildfire Vulnerabilities

Assess trails for hazard tree mitigation

- primarily a geographic information system exercise (trails X high fire severity) followed by a walk through and potential follow-up treatments.

Assess fire roads for Clean Water Act compliance

- drive-by assessment with potential follow-up treatments.

Assess utility corridors for hazard tree mitigation

- drive-by assessment with potential follow-up treatments.

Assess defensible space thinning

- TA by TA with potential follow-up treatments

Assess damage to perimeter fences

- primarily a drive-by assessment with potential follow-up treatments.

None of the projects or assessments have been scoped out in any detail. Table 10 shows approximate acreage, cost/acre, an estimated total base cost, and a complexity factor. Estimates of the base cost/acre were generated by PM-IP. The base cost is an estimate of the average thinning subcontract and does not include planning and administrative costs. In addition, these projects have inherent safety, security, and environmental compliance factors that will increase the complexity and potential cost of the projects. Examples of different categories of complexities are

1. Terrain/Access
2. Fuels Disposition
3. Potentially Hazardous Materials
4. Secure Areas
5. Threatened and Endangered Species Habitat Compliance

Table 10. Approximate Cost/Acre for IWMT Priority Fuels Reduction Projects.

Project Name	ID #	Acres	Base Cost/Acre	Base Cost ($K)	Complexity
DP Canyon	1	136	1,500	204	Moderate
Los Alamos Canyon	2	589	1,500	883.5	Moderate
Lower Mortandad Canyon	3	123	1,500	184.5	Moderate
Upper Mortandad Canyon	4	24	1,500	36	Moderate
Upper Two Mile Canyon	5	30	1,500	45	Moderate
Two Mile Canyon	6	66	1,500	99	Moderate
Pajarito Canyon at TA-40	7	220	1,500	330	High
SM-66	8	15	1,500	22.5	Moderate
Cañon de Valle	9	111	1,500	166.5	High

Note: Acreages are based on geographic information system calculations. Base cost/acre based on information from PM-IP. The complexity estimate is based on added costs for safety, security, and compliance requirements (see text). Four or five complexities = high, three or less = moderate, no complexities = low.

Many of the identified projects are in canyons. Most of these areas will require work in steep, rocky terrain where access restrictions and worker safety will require additional time and equipment. In most cases, thinned fuels must be removed from the site and disposed of or perhaps burned in place at a later date. Work within areas with potentially hazardous materials will require additional precautions for worker and environmental protection. Work in secure areas requires worker oversight and additional time to comply with LANL security procedures. Work within threatened and endangered species habitat requires compliance with the LANL Habitat Management Plan (LANL 1998).

5.4 Long-Term Budget Forecast

Table 11 shows the estimated 10-year budget forecast for LANL wildfire-related activities. Specific thinning projects identified above are included in the first five years of the Non-fire Fuels Mitigation Task. Costs for the assessments identified above are incorporated into maintenance and monitoring costs within the other tasks.

The prescribed fire budget provides funding in the first year to develop procedures, identify and mitigate safety, security, and environmental issues, and establish collaborative agreements. Subsequent funding provides for a gradual increase in prescribed fire use to a stable maintenance level. Bandelier National Monument personnel use a base cost estimate of $200 per acre that includes planning, unit preparation, execution, and evaluation (M. Rodgers, Bandelier National Monument, personal communication). The LANL base cost estimates used in this forecast are $500 per acre to account for LANL-specific administrative and health and safety requirements. IWMT personnel estimate that on average, approximately 100 acres will be treated with prescribed fire annually. Cost estimates in Table 11 fluctuate to account for potential changes in acreage burned.

The fire road maintenance budget provides early funding for needed repairs and upgrades before leveling off to a stable maintenance level. Both fire road and utilities maintenance budget estimates reflect the uncertainty due to annual weather variations that could damage roads and increase fuel accumulations.

The WFMP budget estimates provide for publication of the WFMP Annual Update as well as a revision of the WFMP every five years. Cost estimates for the annual Fuels and Fire Hazards Monitoring activities includes collection of data on fuel conditions from land cover types throughout the LANL area, data management, quality assurance, and geographic information system formatting, and annual EOC wildfire behavior and risk model updates. The proposed budget for the land cover map database provides for periodic updates to capture changes in land cover types.

Table 11. Ten-Year Plan for LANL Wildland Fire Management Activities and Estimated Budget.

	Year									
Task[1]	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**	**FY11**	**FY12**	**FY13**	**FY14**	**FY15**
Non-fire Fuels Mitigation	500	500	500	500	500	300	300	300	300	300
Prescribed Fire	150	50	100	50	50	100	50	50	100	50
Fire Road Maintenance	250	250	200	50	50	100	150	75	75	100
Utilities Maintenance	50	50	75	75	150	50	50	75	75	150
WFMP Revisions and Annual Update	135	95	95	95	95	135	95	95	95	95
Fuels Monitoring Program	165	165	165	165	165	165	165	165	165	165
Land Cover Map Update	160					160				
Total Estimated Base Cost	1410	1110	1135	935	1010	1010	810	760	810	860

1 Costs shown are estimates in $1,000 increments and do not account for inflation. The budget does not include contingency funds for emergencies or unusual circumstances. No attempt was made to apportion the budget into institutional vs programmatic funding sources.

5.5 Cooperative Agreements and Interagency Contacts

Policy Letters, Agreements, and Memorandums of Understanding between the DOE and External Agencies (LANL 2002b)

Date	Memorandum of Understanding
2003	Joint Powers Agreement-Wildfire Protection Responsibilities-Department of Army, Corps of Engineers/BIA/DOE-LAAO/USFS/NPS/NM Dept. of Energy, Minerals and Natural Resources, 2003.

The New Mexico Joint Powers Agreement establishes guidelines for interagency wildland fire protection. The agreement is signed by the DOE, the Department of Agriculture, the Department of Interior, and the State of New Mexico Energy, Minerals, and Natural Resources Department, Forestry Division.

LANL staff were instrumental in establishing an Interagency Fire Management Center at TA-49 for use by regional agencies in wildfire preparedness and response. The use of the Center is managed under an interagency partnership between LANL, US Forest Service, and National Park Service – Bandelier National Monument. The partnership may expand to include the Bureau of Indian Affairs and the Northern Pueblos Agency. The Center has a garage for two Type 6 fire engines and a fire supply cache. Adjacent to the cache is a three-pad helibase, which sometimes hosts a Type 3 helicopter on a US Forest Service contract and is supported by an interagency US Forest Service/National Park Service helitack module. There are six offices and a room for operations and planning.

The IWMT was formed in 1996 to provide fire control advice and a forum to exchange expertise and information among land stewards in the LANL region. The IWMT was cited for having a significant role in coordinating responses to the Cerro Grande Fire. Staff representing the DOE/NNSA, UC, US Forest Service – Santa Fe National Forest, National Park Service – Bandelier National Monument, Los Alamos County, the Pueblos of San Ildefonso and Santa Clara, and various other interested parties serve on the IWMT. The IWMT is the key sponsor and host of an annual public meeting that addresses various topics and concerns regarding regional wildland fire.

The LANL ENV-ECO personnel also host the EJRC. The EJRC was established in 1998 with a goal of maintaining and enhancing the natural and cultural resources of the East Jemez Mountains so that these resources may be sustained and appreciated by current and future generations. The Council has several technical working groups that focus and report on resource-specific issues and efforts – such as regional wildland fire risks and management. Representatives include DOE/NNSA, UC, US Forest Service – Santa Fe National Forest, US Fish and Wildlife Service, Los Alamos County, San Ildefonso, Cochiti, and Santa Clara Pueblos, the New Mexico Environment Department, New Mexico State Forestry Division, and the New Mexico Department of Game and Fish.

5.6 Contract Suppression and Prescribed Fire Resources

Currently LAFD provides Fire Department Services to LANL through a Precontract Cost Agreement of the Proposed Subcontract #2446L0018-K1. These services include wildland firefighting.

References

Allen, C.D. and D.D. Breshears. 1998. *Drought-Induced Shift of a Forest-Woodland Ecotone: Rapid Landscape Response to Climate Variation*. Vol. 95, pp. 14839–14842. Proceedings of the National Academy of Sciences USA.

Balice, R.G. 2004. Unpublished data. Los Alamos National Laboratory, Los Alamos, NM.

Balice, R.G. 2005. *Fire Hazard Assessments Field Methods; 2005*. LANL-ENV-ECO-ERR-FM-001, R7, Ecology Group. Los Alamos National Laboratory, Los Alamos, NM.

Department of Energy (DOE). 1999a. *Record of Decision: Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory in the State of New Mexico*. Federal Register Vol. 64, No. 181, p. 50797. Washington, D.C.

Department of Energy (DOE). 1999b. *Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory*. DOE/EIS-0238, Albuquerque Operations Office, Albuquerque, NM.

Department of Energy (DOE). 2000. *Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, NM.* DOE-EA-1329. Department of Energy, Los Alamos Site Office.

Department of Energy (DOE). 2003a. *Environmental Protection Program*. DOE 0 450.1. Washington, D.C.

Department of Energy (DOE). 2003b. Memo from DOE Secretary to Undersecretary for Energy, Science, and Environment. Subject: *Department of Energy Wildland Fire Management Policy*. 2002-019296. February 24, 2003.

Department of Energy (DOE). 2004. *Implementation Guide. Wildland Fire Management Program for use with DOE450.1, Environmental Protection Program.* DOE G 450-1.4. Washington D.C.

Energy, Minerals, and Natural Resources Department (EMNRD). 2003. New Mexico Joint Powers Agreement Between the Energy, Minerals, and Natural Resources Department and the United States Federal Agencies of the Departments of Agriculture, Energy, and Interior for Interagency Wildland Fire Protection. Santa Fe, NM. March 14, 2003.

Executive Order (EO). 2000. *Greening the Environment Through Leadership in Environmental Management*. E.O. 13148, April 21, 2000.

Fiedler, C.E., and C.E. Keegan. 2003. *Reducing Crown Fire Hazard in Fire-Adapted Forests of New Mexico*. Pages 39–48 in Omi, P.N., and L.A. Joyce, tech. eds. *Fire, Fuel*

Treatments, and Ecological Restoration: Conference Proceedings. Proceedings RMRS-P-29, USDA Forest Service, Rocky Mountain Research Station.

Incident Operations Standards Working Team (IOSWT). 2002. *Incident Response Pocket Guide*. NFES #1077. National Wildfire Coordinating Group, Boise, ID

Interagency Federal Wildland Fire Policy Review Working Group. 2001. *2001 Federal Wildland Fire Management Policy: Guiding Principles, Policies, and Implementation Actions*. Pages 21–32 in *Review and Update of the 1995 Federal Wildland Fire Management Policy*. National Interagency Fire Center, Boise, ID.

International Fire Code Institute (IFCI). 2000. *Urban-Wildland Interface Code*. International Fire Code Institute, Whittier, CA. January 2000.

Los Alamos County. 2005. *Los Alamos County Hazard Mitigation Plan*. Accessed at: http://www.lac-nm.us/index.asp?Type=B_BASIC&SEC={2F7E2150-0D56-4E59-B51B-49C2769FA6D0}

Los Alamos Fire Department (LAFD). 2005. *Los Alamos County Fire Department Standards of Response Coverage. (LANL Response).* Draft. Los Alamos, NM.

Los Alamos National Laboratory (LANL). 1998. *Threatened and Endangered Species Habitat Management Plan*. Los Alamos National Laboratory report LA-CP-98-96. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2000a. *Cerro Grande Fire: Aftermath Activities to Reduce the Potential Movement of Contamination at Potential Release Sites*. Los Alamos National Laboratory report LA-UR-00-3767. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2000b. *Los Alamos National Laboratory Emergency Rehabilitation Project Plan.* Los Alamos National Laboratory report LA-UR-00-3085. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2001a. *Comprehensive Site Plan 2001*. Los Alamos National Laboratory report LA-UR-99-6704. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2001b. *Wildfire Hazard Reduction Project Plan*. Los Alamos National Laboratory report LA-UR-01-2017. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2001c. *Site + Architectural Design Principles*. Los Alamos National Laboratory report LA-UR-01-5383. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2002a. *Progress Report on Los Alamos National Laboratory Cerro Grande Fire Rehabilitation Activities One Year After Burned Area Rehabilitation*. Los Alamos National Laboratory report LA-UR-02-4921. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2002b. *Los Alamos National Laboratory Emergency Management Plan*. Los Alamos National Laboratory report LA-12900 Rev. 1.5. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2003a. *Quality Management Plan for the Meteorology and Air Quality Group*. RRES-MAQ-QMP, R-7. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2003b. *Progress Report on Los Alamos National Laboratory Cerro Grande Fire Rehabilitation Activities: Status of Burned Area Rehabilitation Two Years Postfire*. Los Alamos National Laboratory report LA-UR-03-5196. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2003c. *Progress Report on Los Alamos National Laboratory Cerro Grande Fire Rehabilitation Activities*. Los Alamos National Laboratory report LA-UR-03-7139. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2004a. *Ten-Year Comprehensive Site Plan*. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2004b. *Cultural Resources Management Plan*. Los Alamos National Laboratory report LA-UR-04-8964. Los Alamos National Laboratory, Los Alamos, NM.

Los Alamos National Laboratory (LANL). 2004c. *Site and Project Planning*. Laboratory Implementation Requirement LIR 210-01-01.1. Los Alamos, NM. Revised on March 1, 2004.

National Fire Protection Association (NFPA). 1995. NFPA 1051. *Standard for Wildland Fire Fighter Professional Qualifications, 1995 Edition*. Quincy, MA.

National Fire Protection Association (NFPA). 2002a. NFPA 1144. *Standard for Protection of Life and Property from Wildfire, 2002 Edition*. Quincy, MA.

National Fire Protection Association (NFPA). 2002b. NFPA 1051. *Standard for Wildland Firefighter Professional Qualifications, 2002 Edition*. Quincy, MA.

National Fire Protection Association (NFPA). 2003a. NFPA 5000. *Building Construction and Safety Code, First Edition*. Quincy, MA.

National Fire Protection Association (NFPA). 2003b. NFPA 1143. *Standard for Wildland Fire Management, 2003 Edition*. Quincy, MA.

National Fire Protection Association (NFPA). 2005. NFPA 70. *National Electric Code, 2005 Edition*. Quincy, MA.

National Interagency Fire Center (NIFC). 2001. *Review and Update of the 1995 Federal Wildland Fire Management Policy*. Boise, ID.

National Interagency Fire Center (NIFC). 2004. *Glossary of Wildland Fire Terms*. Accessed at: http://www.nifc.gov/fireinfo/glossary.html on December 17, 2004.

National Nuclear Security Administration (NNSA). 2002. *Integrated Natural and Cultural Resources Management Plan for Los Alamos National Laboratory*. Office of Los Alamos Site Operations, Los Alamos, NM. September, 2002.

National Nuclear Security Administration (NNSA). 2004. Memo from DOE Compliance Officer to NNSA Los Alamos Site Office Manager. Subject: *Issuance of a Finding of No Significant Impact for the Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, NM. (DOE/EIS-1329).* EM:8EW-001. October 18, 2004.

National Park Service. 2002. Director's Order #18: *Wildland Fire Management*. Office of Policy and Regulations, Washington, DC.

New Mexico Environment Department (NMED). 2003a. *New Mexico Resource Mobilization Plan*. Energy, Minerals, and Natural Resources Division, Santa Fe, NM.

New Mexico Environment Department (NMED). 2003b. *New Mexico Smoke Management Program Guidance Document*. Air Quality Bureau, Santa Fe, NM.

Santa Fe National Forest (SFNF). 2005. *Santa Fe National Forest Fire Management Plan*. USDA Forest Service, Santa Fe, NM.

Scott, J.H., and E.D. Reinhardt. 2001. *Assessing Crown Fire Potential by Linking Models of Surface and Crown Fire Behavior*. United Stated Department of Agriculture Rocky Mountain Research Station, Research Paper RMRS-RP-29.

Southwest Area Coordinating Committee. 2003. Southwest Area Mobilization Guide. Santa Fe, NM.

Southwest Area Wildland Fire Operations (SAWFO). 2005. Southwest Area Wildland Fire Operations. Accessed at: http://www.fs.fed.us/r3/fire/ on July 13, 2004.

Tomecek, D., B. Smeaton, J. Granito, and T. Parker. 2003. Needs Assessment: Fire Prevention and Suppression Services and Resources, Los Alamos National Laboratory (Draft A). 71579-SOL-03. Hughes Associates, Inc., Brownfield, CO.

URS Corporation (URS). 2002. *Fire Road Hardening Project Los Alamos National Laboratory*. Project ID 100324. Albuquerque, NM. September 9, 2002.

US Forest Service (USFS). 2003. *Sanford Prescribed Fire Review Team. Sanford Prescribed Fire Review*. US Department of Agriculture, Dixie National Forest, Intermountain Region.

US Forest Service (USFS). 2004. Pacific Southwest Region, Fire and Aviation website. Accessed at http://www.fs.fed.us/r5/fire/intel/ncsc/pred_serv/definitions/erc.shtml. July 13, 2004.

Appendix 1. Matrix of Activity Restrictions Under a Wildfire Alert

Fire Danger Rating	Wind Parameters	Shot/Burn Activity	Construction Sites	Fuels Mitigation	Spark Producing Activities	Non-Motorized Activities
Red Flag		Prohibited	Approved with restrictions: Approved hazard control plan	Prohibited	Prohibited	Approved with restrictions: Two-way communications management accountability
Extreme	*<10 mph	Approved with restrictions: Follow mitigation requirements listed in the approved burn plan or DX shot mitigation procedure.	Approved with restrictions: Approved hazard control plan	Approved with restrictions: Approved communications plan Approved fire suppression plan Field activities must be approved by line management.	Approved with restrictions: Spark or flame permit Two-way communications Field activities must be approved by line management. **No off road driving	Approved with restrictions: Two-way communications Field activities must be approved by line management.
Very High	*<10 mph	Approved with restrictions: Follow mitigation requirements listed in the approved burn plan or DX shot mitigation procedure.	Approved with restrictions: Approved hazard control plan	Approved with Restrictions: Approved communications plan Approved fire suppression plan Field activities must be approved by line management.	Approved with restrictions: Spark or flame permit Two-way communications Field activities must be approved by line management.	Approved with restrictions: Field activities must be approved by line management.
High	*<10 mph	Approved with restrictions: Follow mitigation requirements listed in the approved burn plan or DX shot mitigation procedure.	Approved with restrictions: Approved hazard control plan	Approved with restrictions: Two-way communications Field Activities must be approved by line management.	Approved with restrictions: Spark or flame permit Field activities must be approved by line management.	Approved
Moderate	*<20 mph	Approved with restrictions: Follow mitigation requirements listed in the approved burn plan or DX shot mitigation procedure.	Approved with restrictions: Approved hazard control plan	Approved with restrictions: Two-way communications Field activities must be approved by line management.	Approved with restrictions: Spark or flame permit	Approved
Low	*<20 mph	Approved with restrictions: Follow mitigation requirements listed in the approved burn plan or DX shot mitigation procedure.	Approved with restrictions: Approved hazard control plan	Approved with restrictions: Two-way communications Field activities must be approved by line management.	Approved with restrictions: Spark or flame permit	Approved

*Wind speed in excess of the listed speed would cause the Fire Danger Rating to advance to the next higher level.
**Road: For purposes of this document, a road must be improved by either pavement, or by base course. A two-wheel rut path is not considered a road.

NOTES: Any Federal, State, or local officer, or member of an organized rescue or firefighting force in the performance of an official duty are exempt from this procedure.
Wind data are standardized using the LANL Weather Machine, Tower 6 postings.

Appendix 2. Minimum Impact Suppression Tactics (IOSWT 2002)

The intent of minimum impact suppression tactics is to suppress a wildfire with the least impact to the land. Fire conditions and good judgment dictate the actions taken. Consider what is necessary to halt fire spread and contain it within the fireline or designated perimeter boundary.

A. Safety
- Safety is of utmost importance
- Constantly review and apply the "Watch Out Situations" and "Fire Orders."
- Be particularly cautious with
- -Unburned fuel between you and the fire
- -Burning snags allowed to burn
- -Burning or partially burned live and dead trees
- Be constantly aware of surroundings, expected fire behavior, and possible fire perimeter 1 or 2 days hence.

B. Fire Lining Phase
- Select procedures, tools, equipment that least impact the environment.
- Seriously consider using water as a firelining tactic (fireline constructed with nozzle pressure, wetlining).
- In light fuels, consider:
  - Cold-trail line.
  - Burning-out and use of "gunny" sack or swatter.
  - Constantly rechecking cold-trailed fireline.
  - If constructed fireline is necessary, use minimum width and depth to check fire spread.
- In medium/heavy fuels, consider:
  - Using natural barriers and cold-trailing.
  - Cooling with dirt and water, and cold-trailing.
  - If constructed fireline is necessary, use minimum width and depth to check fire spread.
  - Minimizing bucking to establish fireline. Preferably move or roll downed material out of the intended constructed fireline area. If moving or rolling is not possible, or the downed log/bole is already on fire, build line around it and let material be consumed.
- Aerial fuels – brush, trees, and snags:
  - Adjacent to fireline: limb only enough to prevent additional fire spread.
  - Inside fireline: Remove or limb only those fuels that if ignited would have the potential to spread fire outside the fireline.
  - Brush or small trees that are necessary to cut during fireline construction will be cut flush to the ground.
- Trees, burned trees, and snags:
  - MINIMIZE cutting of trees, burned trees, and snags.

- Live trees will not be cut, unless it is determined that they will cause fire spread across the fireline or endanger workers. If tree cutting occurs, cut the stumps flush with the ground.
- Scrape around tree bases near fireline if hot and likely to cause fire spread.
- Identify hazardous trees with either an observer, flagging, and/or glow sticks.

- When using indirect attack:
  - Do not fall snags on the intended unburned side of the constructed fireline, unless they are a safety hazard to crews.
  - On the intended burn-out side of the line, fall only those snags that would reach the fireline should they burn and fall over. Consider alternative means to falling, i.e., fireline explosives, bucket drops.
  - Review items listed above (aerial fuels; brush, trees, and snags).

C. Mop-Up Phase

- Consider using "hot-spot" detection devices along perimeter (aerial or hand-held).
- Light fuels:
  - Cold-trail areas adjacent to unburned fuels.
  - Do minimal spading; restrict spading to hot areas near fireline.
  - Use extensive cold-trailing to detect hot areas.
- Medium and heavy fuels:
  - Cold-trail charred logs near fireline; do minimal scraping or tool scarring.
  - Minimize bucking of logs to check for hot spots or extinguish fire; preferable to roll the logs and extinguish the fire.
  - Return logs to original position after checking or ground is cool.
  - Refrain from making boneyards; burned/partially burned fuels that were moved should be arranged in natural position as much as possible.
  - Consider allowing larger logs near the fireline to burnout, instead of bucking into manageable lengths. Use lever, etc., to move large logs.
- Aerial fuels – brush, small trees, and limbs.
  - Remove or limb only those fuels that if ignited, have potential to spread fire outside the fireline.
- Burning trees and snags.
  - See Section B.